ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT, PUERTO BOLÍVAR PROJECT

PUERTO BOLÍVAR — PHASE 1

– ENVIRONMENTAL AND SOCIAL BASELINE –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Content Table

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT, PUERTO BOLÍVAR PROJECT

PUERTO BOLÍVAR — PHASE 1

– ENVIRONMENTAL BASELINE AND DETERMINATION OF ENVIRONMENTAL LIABILITIES —

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Table of Contents

Index of Figures

EXECUTIVE SUMMARY

ECOSAMBITO C.LTDA. has carried out an Environmental Baseline, which includes a study of the identification of environmental liabilities (Environmental Site Assessment - Phase I, ESA) of the sites that are part of the Project “Puerto Bolivar - Phase 1”, located at Av. Bolivar Madero Vargas S/N, Port Terminal of Puerto Bolivar, township of Machala, El Oro Province, at the request of YILPORT TERMINAL OPERATIONS — YILPORTECU S.A.

The ESA was conducted in accordance with the scope and limitations of the American Society for Testing and Materials (ASTM) Practice E 1527-13, and has been performed by an environmental professional (see Annex VII.) as described in ASTM and 40 C.F.R. Section 312.10.

The property in question is owned by the Port Authority of Puerto Bolivar (hereinafter APPB, by its acronym in Spanish), is located in Av. Bolivar Madero Vargas S/N, Port Terminal of Puerto Bolivar, in the township of Machala, El Oro Province, in a mixed-use area (residential and commercial). As shown in Annex II, the implantation area consists of an irregular inverted trapezoidal plot of land with an area of 72 hectares; a rectangular plot of 3.1 hectares where Pier 6 will be built. Additionally, although not owned by APPB or YILPORTECU S.A., the areas corresponding to the Access Channel and Maneuvering Area of Puerto Bolivar, as well as the offshore sediment tank, were assessed, in accordance with the areas included in the Intersection Certificate No. MAE-SUIA-RA-DPAEO-2017-207553, issued by the Ministry of Environment in April 2017.

The current breakwater Pier (Piers 1 and 2) was built in 1962, and in 1970 the Port Authority of Puerto Bolivar was created, which from that date took over the administration of the Port Terminal. Within its administration, work was carried out aimed at gaining and consolidating land by means of breakwater walls, which were then filled and improved. In 5 decades of existence, improvements and expansion of capacities and service facilities have been made, the latest in 2012 with the construction of Pier 5.

In August 2016, the DELEGATED MANAGEMENT CONTRACT FOR THE "DESIGN, FINANCING, EQUIPMENT, EXECUTION OF ADDITIONAL WORKS, OPERATION AND MAINTENANCE OF THE PORT TERMINAL OF PUERTO BOLÍVAR" was signed.

In March 2017, YILPORTECU takes over the physical administration of the Port Terminal of Puerto Bolivar.

Since the start of operations by YILPORTECU S.A., improvement works have been carried out, including those of the Maintenance Plan, such as remodeling in certain warehouses and buildings, re-roofing of tracks, changing rails at Pier 5; as well as complementary studies, equipment and software, which are part of the works contemplated in the Investments for the development of Phase I. In addition, the Terminal has made its own investments to improve its performance.

As part of the investments contemplated in the development of the implementation of Phase I, two dredging campaigns have been carried out in the access channel and maneuvering area, for a total of 9,832,628m^3, which have been dumped in their entirety in the offshore sediment deposit tank.

The findings of this assessment are summarized below:

- This assessment has revealed no evidence of Recognized Environmental Conditions (REC) in relation to the project area.
- A de minimis condition is a condition that generally does not present a threat to human health or the environment and would generally not be the subject of an enforcement action if reported to the appropriate governmental agencies. This assessment has not revealed evidence of de minimis conditions.
- A Historical Recognized Environmental Condition (HREC) refers to an environmental condition that would have been considered an REC in the past, but which, based on subsequent assessment and/or remediation performed. The present evaluation has not revealed evidence of HREC in relation to the project area.
- Conditions that could affect the environmental professional's ability to identify RECs in the project area include the lack of or availability of technical reports and/or handover certificates describing the technical specifications of the hydrocarbon and other storage facilities that have been built, as well as the lack of certificates of integrity of the fuel storage tanks.
- Another conclusion of the evaluation is that there have been uses and events in the area of influence of the project that could have generated environmental liabilities outside the APPB properties evaluated.

Recommendations and Conclusions

Based on the information provided in this report, it is recommended that an Environmental Site Assessment - Phase II (as defined for ASTM Standard Practice E1903 - 19) be performed to establish the adequacy of their fuel storage and spill containment facilities and the existence of environmental liabilities in the sediments of the Santa Rosa estuary and the existence of environmental liabilities in the sediments of the Santa Rosa estuary.

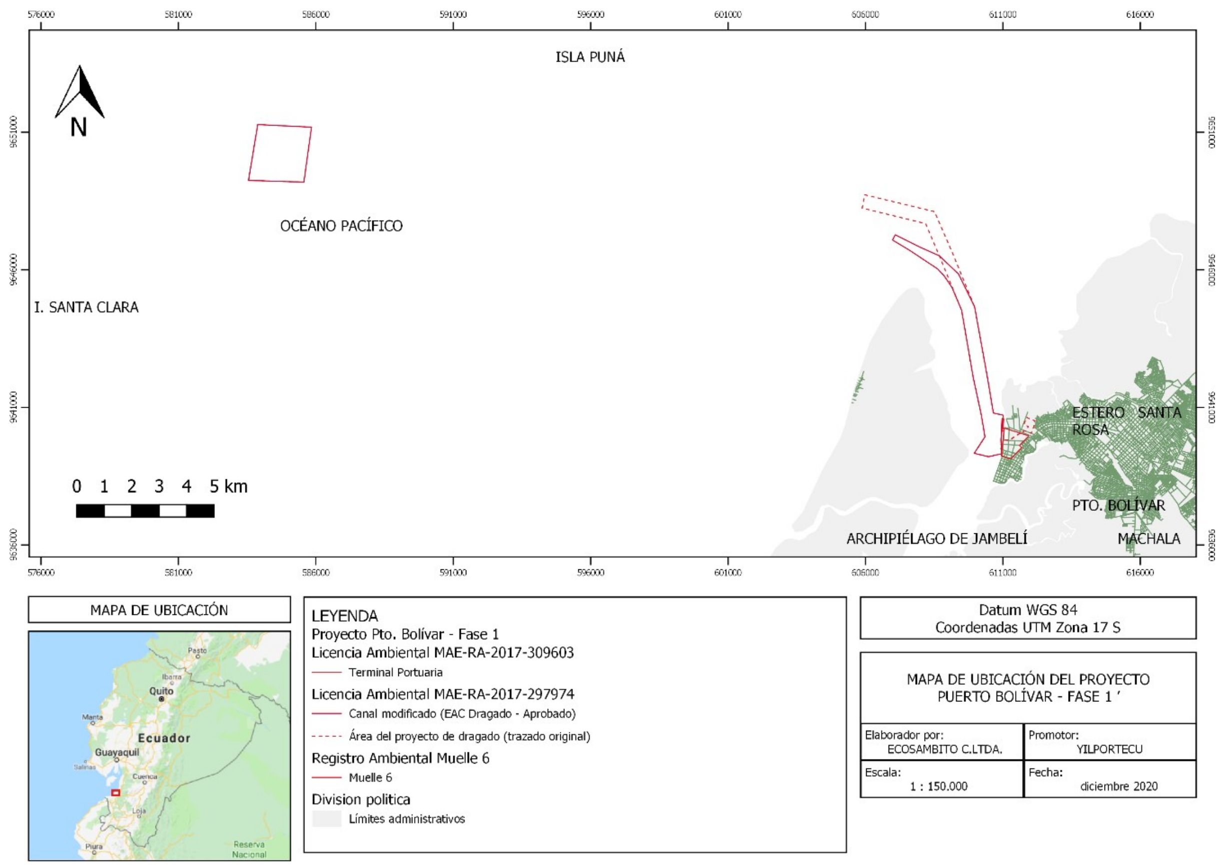
ENVIRONMENTAL BASELINE

1. Site diagnosis and characterization

1.1 Area evaluated

The area subject of this assessment is the total area included in projects with current environmental regularization of YILPORT (the User), that is: Dredging of Piers 1, 2, 3, 4 and 5, 6, the maneuvering Area and Access Channel of Puerto Bolivar[1], the Port Terminal and, the area where Pier 6 will be built. This is equivalent to the minimum search area (AMB, by its acronym in Spanish), see Figure 1.

Figure 1 . Puerto Bolivar Phase 1 project implementation area



[1] The analysis includes the modified path of the access channel, carried out by a Complementary Environmental Assessment. To date, this process is awaiting the assignment of the Social Facilitator by the Ministry of Environment and Water (MAAE, by its acronym in Spanish).

Location map

Key
Puerto Bolivar Project - Phase 1
Environmental License MAE-RA-2017-309603
Port Terminal
Environmental License MAE-RA-2017-297974
Modified Channel (EAC Dredging - Approved)
Dredging project area (original layout)
Environmental Record Pier 6
Pier 6
Political Division
Administrative Boundaries

Datum WGS 84
UTM coordinates Zone 17 S

Puerto Bolivar Project Location Map - Phase 1
Prepared by: ECOSAMBITO C.LTDA
Promoter: YILPORTECU
Scale:
1 : 150.000
Date:
December 2020

The limits defined for the Puerto Bolivar project area are as follows:

1.1.1 North: Jambelí Naval Lyceum, Jambelí Marine Corps Battalion (BIMJAM, by its acronym in Spanish), mangrove area under AUSC of Aso. Porteño Estuary, an informal populated area adjacent to the east side of the sediment pools, and the Virgen del Cisne neighborhood.

1.1.2 South: APPB, populated area of Puerto Bolivar (Rafael Morán Valverde, Virgen del Cisne, Centenario, and Atahualpa neighborhoods.

1.1.3 East: Populated area of Puerto Bolivar (Virgen del Cisne II, Harry Álvarez, El Pacífico, La Unión, Primero de Abril, Amazonas, Portuaria Luis Felipe Sánchez, and Puerto Nuevo neighborhoods).

1.1.4 West: Santa Rosa estuary, Jambelí island (opposite shore).

1.1.5 For the activities carried out in the water body of the Santa Rosa estuary: offshore sediment tank, access channel, maneuvering area and pier apron, the limits correspond to the outer perimeter of the intervention area defined by the polygons included in the current Intersection Certificates.

1.2 YILPORT Infrastructure

In this section, we will focus on the storage infrastructure for fuels, hydrocarbons in general, hazardous waste storage, and others that provide services inside the port terminal, and that use hazardous substances for their operation that are considered to have a potential impact on the environment due to accidental spills.

This infrastructure was evaluated on the basis of available information (design plans, technical report, inventory description, etc.) and by visual inspection.

1.2.1 Generation and distribution of electric power

1.2.1.1 Electrical Substation

In this area there are two clearly differentiated areas: the substation that receives electrical energy from the national distribution system (69kV) and has 2 transformers with a capacity of 10,000 KVA each; and the bank of step-up transformers (4 units of 2,000 KVA each) that receive the energy generated by the generators in the Cell Room 1.

1.2.1.2 Cell Room 1

There are facilities for 5 diesel generators for emergencies, although to date only 2 generators are installed. The room has 3 tanks of 300 gallons each, for daily fuel supply, which are located inside a concrete tank.

It is the first emergency power generation station implemented at the port terminal, and consists of an electrical substation, an emergency generator, and a semi-buried steel tank for diesel fuel storage. At present, it has in its outer left area, an area under cover and a tank for the temporary storage of hazardous waste.

1.2.1.3 Cell 1

This includes facilities for 3 diesel generators for emergencies, of 680 KV each. These are fed by 3 tanks of 300 gal each, which in turn are supplied from the main tank located outside. It has a 2000 KVA electric transformer.

1.2.2 Fuel Area

In this area there are 3 steel tanks, each with its own tank and maneuvering area. The largest capacity tank (11,000 gal) is the one that supplies the daily tanks of Cell Room 1 by underground metal pipe, which covers a distance of approximately 40 m. It is assumed that this pipe is fitted, however, this has not been proven, as there is no technical memory of its installation.

The other 2 tanks, of less capacity, are employed by companies providing services to supply their machinery operating in the port.

All main fuel tanks (Tanks 1, 2, and 3 in the Fuel Area, and Cell 1 tank) are supplied from the diesel supplier's tankers.

1.2.3 Collection of hazardous wastes

It occupies part of Cell 1, mainly its maneuvering yard on the left side, and has an area with a tank and a free area, both under cover. Its storage capacity is reduced (9 m^2) so it must be evicted on a quarterly basis. Mainly stored here: spent or used oils (NE-03)[2], used mineral oil filters (NE-32)[2], adsorbent material contaminated with hydrocarbons and others (NE-42 and NE-43)[2].

1.2.4 Areas where machinery maintenance is performed

The only authorized sites for carrying out machinery and/or container maintenance activities are:

[2] Ministerial Agreement 142, Official Register Supplement 856 of 21/12/2012, NATIONAL LIST OF HAZARDOUS CHEMICALS HAZARDOUS WASTE.

1.2.4.1 Yard 9

Assigned to OPSC[3] ARETINA, who carry out container maintenance activities (metalworking, painting, insulation, and refrigeration equipment), and where minor maintenance is performed to the company's container ship equipment. As waste, they mainly generate NE-03, NE-32, and NE-42. They have environmental regularization of the Ministry of the Environment for their operations inside the terminal. The yard has no gutters or effluent collection wells, so that water contaminated with hydrocarbons (a mixture of water from washing containers and stains from dripping and/or small spills of grease and oil from maintenance work) and paint run off over the sidewalk into the gutters of the rainwater system. As part of ARETINA's commitment, the latter must implement an effluent collection and treatment system, to be implemented until the end of 2020.

1.2.4.2 Yard 2

Assigned to OPC[4] OROESTIBAS, who carry out cargo handling activities inside the terminal, and use this yard for the maintenance of their road and cargo handling equipment (container ships, forklifts, others). As waste, they mainly generate NE-03, NE-32, and NE-42. They have a washing area and a wall for effluent collection, a grease trap with 3 chambers and a pre-sand trap, which is connected to the terminal's AASS network, and a container adapted for the storage of hazardous waste. They have environmental regularization of the Ministry of the Environment for their operations inside the terminal.

1.2.4.3 Warehouse 12

Assigned to the YILPORT maintenance department, this warehouse is mainly used for metal-mechanical work, electrical maintenance (lights and other minor items), and the collection of supplies for the operation of the quay cranes (various lubricants), and some types of solid waste such as scrap metal (NE-09), lights and light bulbs (NE-40), adsorbent material (NE-42) and other minor items, until they are handed over to the environmental manager. The site has an effluent collection channel with a sand trap and step grease trap, and connected to the AASS system.

1.2.4.4 Pier 5

This site is intended for docking ships and handling cargo to and from ships, and this is where YILPORT's two RTG cranes operate. Due to the size of the cranes, routine maintenance — including oil and filter changes — must be performed on site, taking the respective precautions. Pier 5 does not have facilities for maintenance or collection of effluents or spills.

---

[3] Port operator of related services.

[4] Port cargo operator.

1.2.5 Stormwater and sanitary sewers and effluent treatment plant

The original sewage system of the port terminal was of the combined type, that is, it functioned as both a stormwater and sanitary sewer.

In 2006, studies were carried out for the design of the new sewage system (CAMINOSCA C. LTDA., 2006). In its design, the observations made by APPB to Alternative 1 (presented by CAMINOSCA in Phase II — Analysis of alternatives) are collected, which establish:

- Use the existing combined sewer system as a stormwater sewer system, with the necessary modifications (required at the time by APPB);
- That the final layout of the sanitary sewage system, as far as possible, go on the sidewalks;
- Carry out the design of the treatment system (PTAR) presented as Alternative 1 by CAMINOSCA and approved by APPB, consisting of:
    - Raw Water Pumping Station, which has an equalization chamber for ½ hour of retention at peak flow of 3.5 l/s, two submersible pumps that lift the water to the pumping plant and the electrical components such as starters, protectors and meters.
    - The inspection and cleaning chamber, which serves to eventually remove foreign materials from entering the system, and to ensure that the water enters the plant free of solids.
    - Treatment tank, IMHOFF, which is the place where the actual treatment takes place. It is covered with removable tiles to check operation anywhere and remove creaming and foams.
    - Two up flow filters, composed of gravel, which serves to polish the treatment achieved in the tank. It has a valve chamber to be able to independent the operation of each one.
    - Treated Water Pumping Station, which has an equalization chamber for ½ hour of retention at peak flow of 3.5 l/s, two submersible pumps that lift the water to the discharge well, with a residual pressure of 3 m, in order to optimize the opening of the swing check valve. Of these pumps one is kept in reserve. Additionally, the station has electrical components such as starters, protectors and meters.
    - Pumping line. It is the one that leads the treated water to the discharge, composed of a 110 mm diameter PVC pumping pipe; and a discharge well with a swing check valve that prevents the entry of seawater at high tide and a discharge structure.

For sewerage systems in general and the treatment plant, a 25-year period has been considered; and the existing concrete pipes and manholes were adopted for the stormwater sewerage design, and for the sanitary sewerage, PVC pipes with PVC inspection manholes. The network has been designed with minimum depths of 1.10 m to 4 m with respect to the natural ground level.

1.2.6 Onshore sediment pools

The sediment ponds correspond to an area of approximately 12.9 hectares located northeast of the Port Terminal, on the former ISSFA premises.

However from what was foreseen in the EIA of the Project, these pools have not been used for the described purposes, and in technical evaluations carried out (SURCONSUL, 2017), the potential risk of infiltrations in the east wall of Pool No. 2, which is adjacent to an informal urban settlement installed as a result of the flattening and filling of the land where it is located.

These pools remain in disuse, and their presence has allowed rainwater to accumulate during the winter season, posing a latent risk for the generation of pests in the sector.

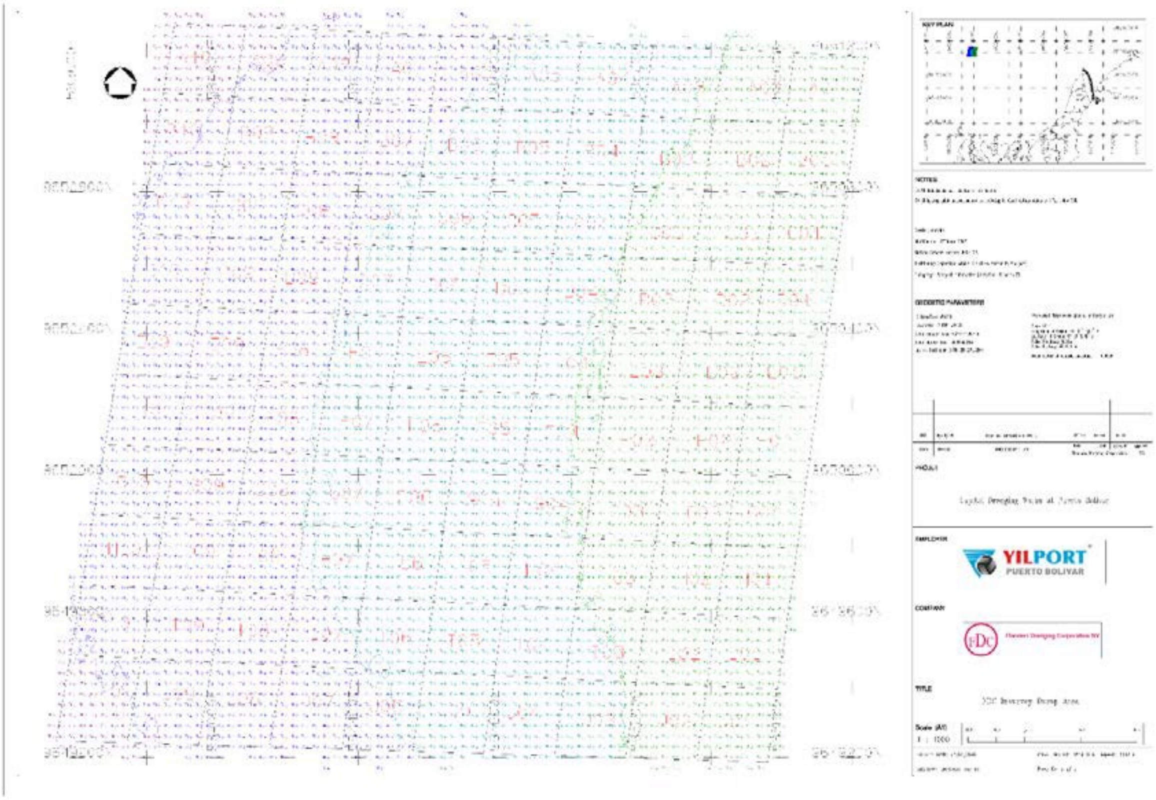
Currently, this area has been excluded from the dredging project by means of a Complementary Environmental Study that has been pre-approved by the MAAE, and is currently awaiting the assignment of the Social Facilitator by the MAAE.

In the last week of August 2020, an organized group of citizens carried out a massive invasion in the area of the sediment pools north of the port terminal, who, alleging a lack of housing options, took over the site, settling in with precarious constructions of wood and plastic and other waste materials. To date, neither the owners of the property (Armada del Ecuador), nor the municipal government, within its competencies, have initiated actions in the area.

1.2.7 Offshore dumping area

The offshore sediment dumping area is 4 km2 (2 km per side), located 13.75 miles from the sea buoy (25 km), and with depths in excess of -30m MLWS (and up to -40m MLWS). To ensure a homogeneous disposal of the dredged sediments, the basin is subdivided into 100 areas of 4 ha each (200 m x 200 m on each side), each sub-area being assigned according to bathymetry, and used as a deposition area for each of the trips made by the dredge vessels involved in the dredging.

Figure 2 Offshore division map of the dumping area.



Prepared by: FLANDERS DREDGING CORPORATION
Date: march 2018

1.3 New services

From February 2020 to October 2020, stockpiling and shipment of approximately 60,000 tons of mineral concentrate (20-30% copper) began. This material was collected in warehouses 1,2,3,4,5 and 6, and in yards 8 and 3.

Table 1. Hydrocarbon storage sites and other facilities

Area	Denomination of the tank	Stored input	Capacity (gal)	Year of construction	Tests performed (year)	Tank (dimensions)	Location (Coordinates 17S UTM)	Observations
Cell 1	Reservoir tank	Diesel	3,500	2003	--	--	(611479, 9639350)	Metallic, Foil with HHAA
	Feeding Tanks	Diesel	3 x 310	2003	--	7,5x8,4x0.2 m	(611479, 9639350)	Metallic
	Substation	Dielectric oil	--	2003	--	--	(611477, 9639341)	2 2000 KVA transformers
DP Collection Center	Tank for waste oils	Waste oils	550	--	--	2,9x1,5x0.2 m	(611493, 9639350)	Concrete under roof
Cell 2	Substation	Dielectric oil	--	2003	--	--	(611074, 9639429)	2 50 KVA transformers
Fuel Area	Tank No.1	Diesel	11,000	2012	--	8,4x11,75x0.65 m	(611517, 9639799)	Metallic
	Tank No.2 (ARETINA)	Diesel	6,069	1985	--	6,9x8,9x0,4 m	(611499, 9639799)	Metallic
	Tank No.3 (OROESTIBAS)	Diesel	1,200		--	3x7,5x0.2 m	(611484, 9639799)	Metallic
Electrical Substation	69 KV network	Dielectric oil	--	2012	--	6,3x8,3x0.32 m	(611463, 9639840)	2 transformers of 10 MV, each with a tank

Area	Denomination of the tank	Stored input	Capacity (gal)	Year of construction	Tests performed (year)	Tank (dimensions)	Location (Coordinates 17S UTM)	Observations
	Generators output	Dielectric oil	--	2012	--	--	(611485, 9639799)	4 2000 KVA transformers
Generators room	Cell Room 1	Diesel	3 x 310	2012	--	10x1,8x0.5 m	(611514, 9639855)	2 x XXX HP Generators
Wastewater Treatment Plant	PTAR	Sewage and gray water	XX m3	2009	--	--	(611450, 9639799)	Reinforced concrete
Well No. 1	Well No. 1	Untreated water	120 m	1998	--	--	(611065, 9639458)	Cased
Reservoir tank No. 1	Reservoir tank No. 1	Untreated water	120 m3	2008	--	--	--	Reinforced concrete
Well No. 2	Well No. 2	Untreated water	152 m	2010	--	--	(611302, 9639321)	Cased
Reservoir tank No. 2	Reservoir tank No. 2	Untreated water	100 m3	2008	--	--	--	Reinforced concrete
Anti-spill equipment warehouse	Tank N/N	Diesel	55	--	--	--	(611086, 9639425)	Metallic
Sediment pool	Pools 1, 2 and 3	--	--	--	SURCONSUL 2017	13 ha	(612098, 9640211)	Occupied by informal settlers

Source: Interviews Dpt. YILPORT Technician, APPB Technicians, field survey, carried out between October 22 and November 5, 2020.
Prepared by: Ecosambito, 2020

1.4 Description of geological and hydrogeological conditions

1.4.1 Geological Component

The study area is located in the southwest of Ecuadorian territory, in the western or coastal region, which occupies 25% of the land; the wet season prevails from January to June, with a rainfall of approximately 80%, and the dry season in the remaining months of the year. The plain is covered by detrital sediments (sands, sandstones, conglomerates) with a strong volcanic contribution from the Sierra. This feature allowed the development of important aquifers of large extent, with generally high variable permeability and with good yields. (INAMHI, 2015)

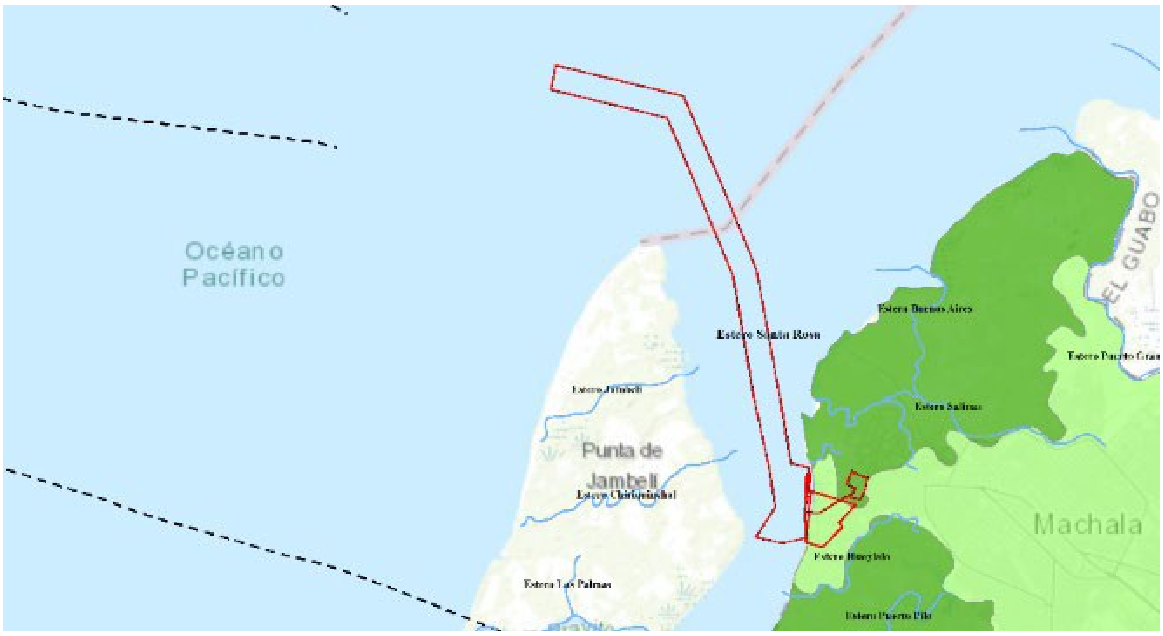
Three physiographic domains can be differentiated in the township of Machala:

1. **Low floodplain of the coast.** It is found over the entire eastern half and part of the north-western part of the township, at low altitudes, mostly at sea level. It is formed by a single morphological context, the *recent alluvial plain*. (Ministry of Agriculture, Livestock, Aquaculture and Fisheries, 2015)

2. **Coastal alluvial medium.** It consists of the water bodies of the rivers Jubones, Buenavista and the Santa Rosa estuary, where Puerto Bolivar is located. (Ministry of Agriculture, Livestock, Aquaculture and Fisheries, 2015)

3. **Mid-coastline.** It is completely occupied by the context *of fluvio-marine forms and deposits* (Ministry of Agriculture, Livestock, Aquaculture and Fisheries, 2015).

Figure 3 Physiographic domains of the project's area of influence



Source: Yilportecu S.A.
Prepared by: Ecosambito, 2020

The area where Puerto Bolívar is located is a coastal alluvial environment, located in the extreme west, formed mainly by the Santa Rosa estuary, where several estuaries flow into, as shown in the geological map of the area, mainly the following estuaries: Guayabal, Caza Camarón and Puerto Pillo, this environment is made up of a fluvial genetic group. The area has frequent flooding, resulting in alluvial soils, as well as slight plateau plains, the product of alluvial-colluvial soils.

The study area includes both current and non-functional fluvio-marine forms and deposits generated at different times of the Quaternary (Holocene, mainly, and Pleistocene). The map shows alluvial deposits of estuaries and mangroves, sands and alluvial estuarine deposits, consisting of clays, silts and sands. In addition, it is a sub-zone of mangroves that comes from Tumbes and continues through the Santa Rosa Estuary, the mangrove forests develop in marshy areas, which are plains near the sea where the water is brackish.

1.4.2 Stratigraphy

1.4.2.1 Machala Unit

The area is distinguished by low areas of soft relief, consisting of fine-grained sediments, which from the tectonic point of view are areas of subsidence and subsidence, with a surface formed by recent sediments.

- **Marine Terraces Q_{Tm1}**

More recent marine deposits are considered to occur south of Puná Island around Cape Salinas and also extend along the Jambelí archipelago; in the zone of direct influence to the Pacific Ocean. These deposits are formed by salt flats, marshes, estuaries, mangroves and beach ridges. Most beach deposits are found isolating mangroves and marshes with tidal channels at different stages of development. These deposits are found overlying Pleistocene sediments of the “Miembro Lechuza”. No dating is available; however, they are considered to be more recent deposits of Holocene. (INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH, 2018)

Restricted to the zone of direct influence of the current ocean and its level variations (tides). The huge contributions of silt and clay dragged by rivers, will be deposited directly in the ocean pit. The area shows sands with cross stratification, with superposition of levels of acceptably classified granulometry, but poorly distributed spatially, since the lenticular strata reflect the bathymetric variations of the ocean or the magnitude of the river floods at the time of debris deposition. (INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH, 2017)

The Jubones parish is made up of two types of soils:

- ✔ Entisol: these are young soils that do not show any defined development of profiles, their composition is similar to the rocky material that gave rise to them.
- ✔ Inceptisol: soils derived from both fluvionic and residual deposits, formed by lithic materials of volcanic and sedimentary nature.

- **Alluvial Plains (Q_{La})**

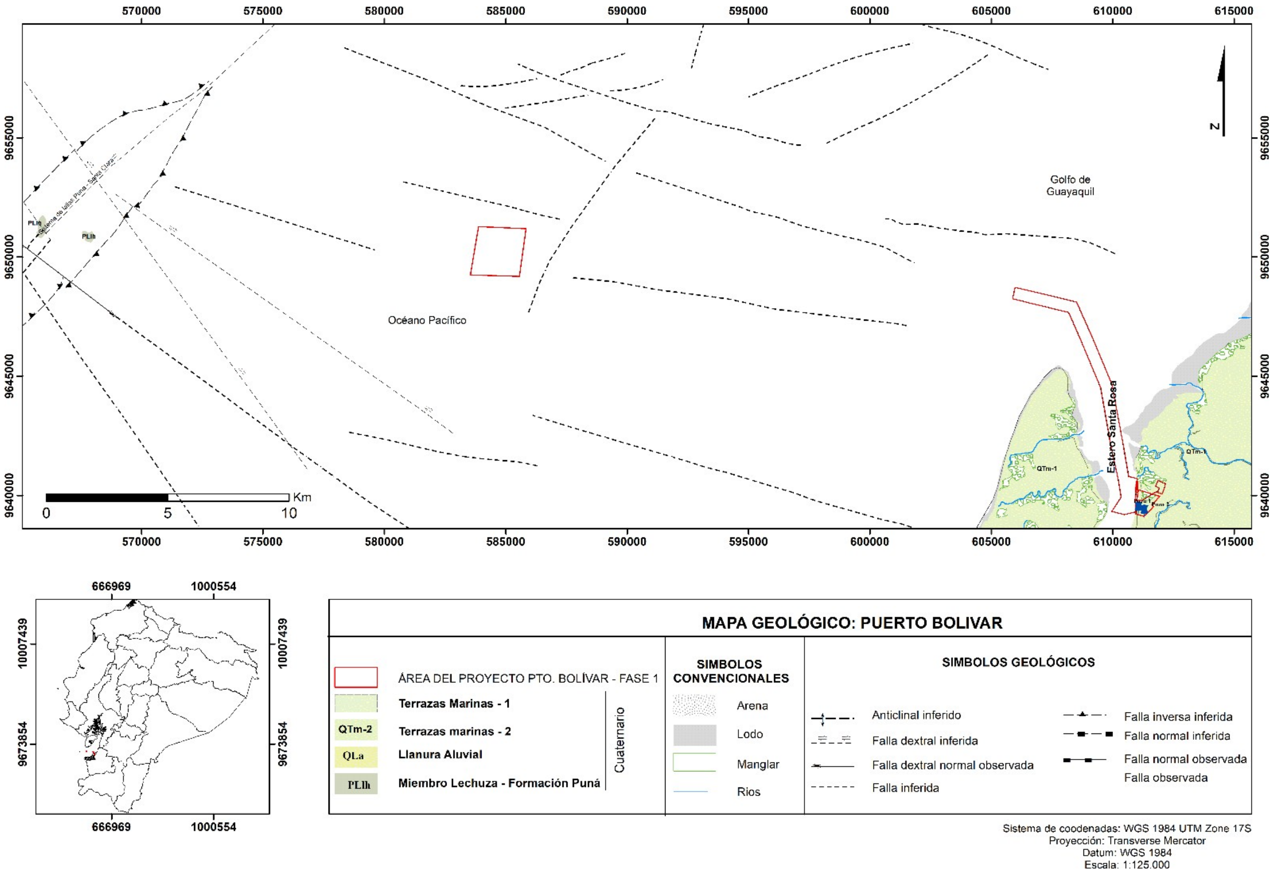
They extend in the slope changes of the boundaries of the mountain range to the coast, below the foothills deposits and covering the geological base of the coastal plain. The terraces, made up of blocks, gravels, silts and sands, are poorly developed. The power of these deposits can reach hundreds of meters, depending on the topography of the substrate. (INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH, 2017).

- **Formation Fortuna (Msf)**

They present tuffs of rhyolitic composition, containing disseminated crystals of plagioclase, biotite and quartz. It discordantly overlies the dacitic tuff bodies. Geochemically and petrographically, it is similar to the tuffs of the Jubones Formation, the difference being that the La Fortuna matrix has a greater amount of fine elements with a vitroclastic texture.

Radiometric dating by fission traces determines an age of 23.2 ±0.8Ma, late Oligocene-early Miocene. (INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH, 2017).

Figure 4 Geological map of the project's area of influence



Geological map: Puerto Bolivar		
Puerto Bolivar Project Area - Phase 1	**Conventional symbols**	**Geological Symbols**
Marine Terraces - 1	Sand	Inferred anticline
Marine Terraces - 2	Mud	Inferred dextral fault
Alluvial Plain	Mangrove	Observed normal dextral fault
Lechuza Member - Puná Formation	Rivers	Inferred fault
Quaternary		Inferred reverse fault
		Inferred normal fault
		Observed normal failure Failure observed

Coordinate system: WGS 1984 UTM Zone 17S
Projection: Transverse Mercator
Datum: WGS 1984
Scale: 1: 125.000

Source: Yilportecu S.A.
Prepared by: Ecosambito, 2020

1.4.3 Hydrogeological Component

The fluvial network of the province is of great importance, born in the high Andean peaks and descends in such a way that it irrigates the lands of the green province, making them fertile and finally flows into the Pacific Ocean. The Santa Rosa Estuary is fed by rivers that flow down from the western slopes of the Dumari, Chilla and Sambotambo mountain ranges. (Vargas, 2002).

The Machala Hydrogeological Unit is composed of a main basin, the Jubones river basin and 6 sub-basins: Balao, Gala, Tenguel, Siete, Pagua, Santa Rosa and Motuche estuary, corresponding to a flat to gentle terrain. Regionally, the climate is influenced by Intertropical Convergence Zones (ITCZ) and the cold Humboldt Current. (Manzano Herrera & Naranjo Calero, 2012).

The water resource for drinking water supply comes from a series of shallow and deep wells. The entire territory of the parish is subject to flooding and surges. (JAMBELÍ PARISH Decentralized Autonomous Governments (GAD, by its acronym in Spanish), 2015)

Two deep wells have been drilled within the facilities of the Port Authority of Puerto Bolivar that belong to the aquifer or recharge area of the Motuche River. The wells are 3 to 200 m deep, NE from 2 to 10 m deep, flow rates between 3 to 28 l/s, pH 6.9, EC between 293 to 1904 μS/cm, and are used for human consumption and irrigation, and may have contamination of agricultural origin. (ESPOL, 2014).

Table 2. Motuche River Basin

Area	309 km^2
Perimeter	103.5 km
Axial length	39.8 km
Width	7.8 km
Basin shape	Oval oblong to rectangular oblong
Topography	Very weak

(Manzano Herrera & Naranjo Calero, 2012)

Well No. 1 of WGS-84 coordinates (611065, 9639458), with a depth of 120 m, 8 inches casing diameter, discharge at 2 inches; the resource is sucked and deposited in a 120 m^3 reservoir, tank then to an elevated tank of 100m^3 and then distributed to the points of use, washing and maintenance of the containers.

Well No. 2 of WGS-84 coordinates (611302, 9639321), with a depth of 152 m, 8-inch casing diameter, 2-inch discharge; the resource is suctioned and deposited in a 100 m^3 reservoir tank, then into an elevated tank of 150 m^3 and used for the consumption of personnel working in the administrative area.

In order to complement the information, hydrogeological data on drilled and excavated wells were collected from Senagua's archives. This also made it possible to describe the aquifer structure of the area, which is linked to alluvial deposits made up of gravels and sands. Its extension is 311.60 Km^2; these units are considered to have primary porosity, intergranular porosity and very high permeability.

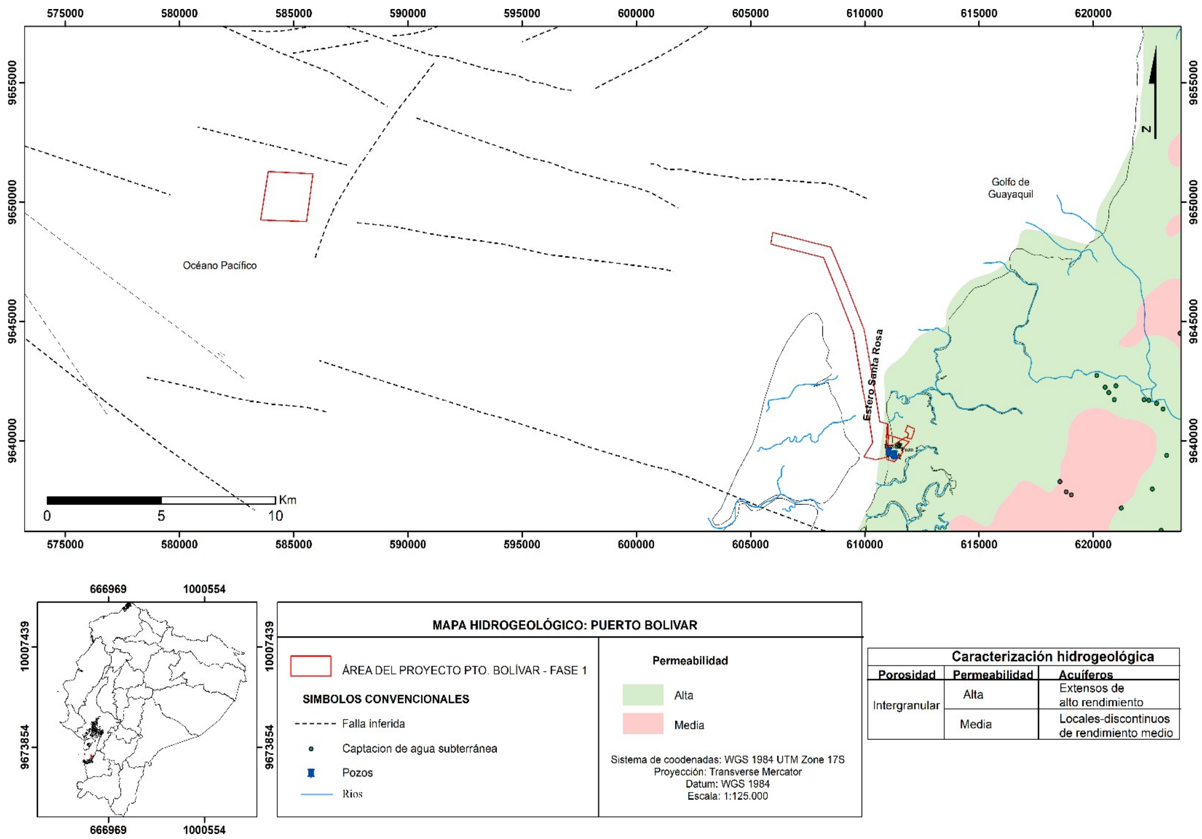
According to INAMHI (2015):

- Aquifers associated with unconsolidated clastic rocks of Quaternary age, with generally high permeability, with relative hydrogeological importance; of local extension, with good water chemical quality; with the possibility of exploitation through shallow wells; and,
- Aquifers in unconsolidated clastic sediments of the undifferentiated Quaternary, which predominantly outcrop in the basins of the Guayas, Taura, Balao, Jubones, San Miguel, Putumayo, Aguarico and Morona rivers; and in the inter-Andean valleys. The extension of these aquifers is regional, although in some places they are limited, free and/or confined, generally of medium to high permeability, with water of good chemical quality in most cases.

Exploitation is carried out through variable depth drilled wells and dug wells.

The conglomerates, sands and gravels that make up the area have high and medium permeability and reach notable thicknesses. A large colluvial deposit is located in the central eastern part, north of the Jubones River. The detrital materials that make it up are sub-rounded blocks and pebbles of volcanic agglomerates to silts and clays decomposed by the weathering of the bedrock in which it rests (F. Macuchi), as a consequence of slope instability as base erosion progresses in weakly tectonic zones. Like the previous ones, alluvial deposits are Quaternary deposits located along rivers where the natural slope decreases. Considerable outcrops are found north of Pasaje and south of Ponce Enriquez. These are unconsolidated deposits of boulders (on riverbanks and riverbeds) covered by sands and silts towards the exposed parts. (Ministry of Agriculture, Livestock, Aquaculture and Fisheries, 2015).

Figure 5 Hydrogeological map of the area of influence of the project.



Hydrogeological map: Puerto Bolivar	
Puerto Bolivar Project Area: Phase 1	Permeability
Conventional symbols	High
Inferred failure	Medium
Groundwater withdrawal	Coordinate System: WGS 1984 UTM Zone 17S Projection: Transverse Mercator Datum: WGS 1984 Scale: 1:125.00
Wells	
Rivers	

Hydrogeological characterization		
Porosity	Permeability	Aquifers
Intergranular	High	High-performance extensions
	Medium	Local-discontinuous medium-performance

Source: Yilportecu S.A.
Prepared by: Ecosambito, 2020

1.5 Risk factors

The flow of cargo transports and/or heavy machinery are factors that could affect the existing civil structures in a given area, such as streets and avenues, gutters and sewage and rainwater wells; and, through these affectations, the infiltration of substances into the subsoil. In addition to rainfall, and because the area studied is located within a high flood risk zone, the degree of transport of these substances is greater. Another factor is the geodynamics of the area where the project is located, which is controlled by the subduction of the Nazca plates under the South American plate, and the movement of the fault system, which terminate to the south in the Gulf of Guayaquil.

The slope factor also influences the study area, considering that the Machala Hydrogeological Unit is a flat to gentle terrain, with a percentage range that varies between 0 and 7% slope. In addition, rainfall facilitates the transport of substances and hydrocarbons to the lower part of the basin. This data can be very useful for determining the amount of soil entrainment by surface streams, aquifer recharge averages and/or soil moisture content. A high annual precipitation rate at a site contaminated with a highly water-soluble compound would cause significant migration. Between Machala - Huaquillas and Santa Isabel - Saraguro, there is evidence of a range that varies between 200 and 900 mm of annual rainfall.

On the other hand, the infiltration rate of a substance spilled on the soil depends on the soil texture, considering impermeable conditions with low and high plasticity silts.

The mechanisms of contaminant transport to aquifers are based on the interaction between the three media: air, water and soil. Contamination of one of the media usually results in subsequent contamination of the others. The behavior of contaminants in a medium is a function of their physicochemical characteristics, mainly: density, solubility, and viscosity; in addition to the characteristics of the surrounding medium such as: soil type, adsorption, permeability, particle size, moisture and organic matter content, suction, water level depth, among others. Climatological factors such as temperature and rainfall also play a role. That is, all physicochemical phenomena define the size and distribution of the contamination plume in an area (Varela, 2007).

Contaminants can reach groundwater in dissolved form, by direct infiltration of surface water and dissolution/leaching, or as a separate liquid, if they are in this state. When they reach the groundwater, contaminants that can dissolve in it will move with it. A combination of a moving groundwater body and a continuous source of contamination can therefore contaminate large volumes of groundwater. Some plumes from long-contaminated spaces can be several kilometers long. Permeability and porosity are important soil factors that help to conclude the migration and retention behavior of a rock medium in the presence of a fluid. Usually, sandy soils have fast infiltration regimes. When soils are sandy, silty or a combination of these, oil spills can reach existing aquifers directly (Varela, 2007).

On the other hand, some hazardous substances dissolve very slowly in water, as is the case with many organic compounds, including heavy hydrocarbons. When these substances infiltrate the soil into the groundwater, faster than they can dissolve, a portion will remain in liquid form. If the liquid is less dense than water, it will float on the surface of the water table, like oil on water. If the liquid is denser than water, it infiltrates and accumulates at the bottom of the aquifer. The flat slope facilitates the settling process of the fixed or heavy hydrocarbon fraction, allowing its accumulation in the sediments, the smaller diameter of the silt particles (less than 0.05 mm) and clay (less than 0.002 mm) offer a larger contact area to retain the fixed hydrocarbon fraction in its matrix (Varela, 2007).

Table 3. Substance transport velocity in low plasticity silts

Sustancia Derramada	Velocidad de Humedecimiento (Vh) [cm/min]	Velocidad de Saturación (Vs). [cm/min]	Velocidad de Transporte (Vt). [cm/min]
Gasolina	4.287	1.35	0.532
Agua Potable	2.8	0.874	0.408
Diesel	0.905	0.309	0.127
Ácido Sulfúrico	0.731	0.193	0.084

Source: (Varela, 2007)

Table 4. Substance transport velocity in high plasticity silts

Sustancia Derramada	Velocidad de Humedecimiento (Vh) [cm/min]	Velocidad de Saturación (Vs). [cm/min]	Velocidad de Transporte (Vt). [cm/min]
Gasolina	5.356	2.534	1.3
Agua Potable	2.121	0.878	0.524
Diesel	2.165	0.773	0.361
Ácido Sulfúrico	0.772	0.186	0.058

Source: (Varela, 2007)

Spilled Substance	Wetting rate (Vh) [cm/min].	Saturation rate (Vs) [cm/min].	Transport rate (Vt) [cm/min].
Fuel			
Drinking water			
Diesel			
Sulfuric Acid			

1.5.1 Sources of risk

In this section we identify the activities and infrastructures existing in the studied area (internal and external) that can generate contamination plumes in the soil and even groundwater, such as agriculture, ports, refinery, service stations, storage tanks, among others.

1.5.1.1 Sources of risk within the project

In the Puerto Bolívar area, marine terraces predominate, which are characterized by sands, silts, clays and some conglomerates, material from weathering. These have intergranular porosity, which allows fluid migration and a high permeability that helps fluid retention, lithology that is not very consolidated because it is from the Quaternary.

According to the studies carried out by CAMINOS Y CANALES C. LTDA (CAMINOSCA C. LTDA., 2006), the plasticity of the materials is medium to high, in a well up to 2.20 m deep (performed in the area of the current Wastewater Treatment Plant PTAR and Fuel Area), so that, according to the seepage velocities, it is relatively higher compared to soils of low plasticity.

This is explained in the following table:

Illustration 1. Composition of the improved surface layer of soil in the port terminal

Prof. (m)	Estratigrafía	Descripción del suelo
De 0,00 0,80		Material de mejoramiento, limos con plasticidad, presencia de agregados pétreos, compactos, y color habano.
De 0,80 2,20		Arcillas, de alta plasticidad, y de elevada humedad, con contenido orgánico, consistencia muy blanda a mediana, color café verdoso, (CH).

Source: (CAMINOSCA C. LTDA., 2006)

Depth (m)	Stratigraphy	Soil description
From 0.00 0.80		Improvement material, silts with plasticity, presence of pale, compact, tan colored aggregates.
From 0.80 2.20		Clays, of high plasticity and high humidity, with organic content, very soft to medium consistency, greenish brown color, (CH).

Illustration 2. Soil stratigraphy in the sample studied.

Estrato I	De 0.00 a 2,00 m Espesor: 2,00 m Descripción: Relleno de lastre
Estrato II	De 2,00 a 4,50 m Espesor: 1,50 m Descripción: arcilla verdosa con residuos de materia orgánica, consistencia de blanda a muy blanda, alta plasticidad. Clasificación SUCS: CH y OH Su de 0.9 a 0,30 t/m^2
Estrato III	De 4,50 a 5,50 m Espesor: 1,00 m Descripción: limo gris verdoso con estratos de arena fina consistencia media Clasificación SUCS: ML
Estrato IV	De 5,50-6,50 m (fin de perforación) Espesor medido hasta fin de perforación: 1,00 m Descripción: arena fina limosa gris verdosa medianamente compacta Clasificación SUCS: SM N (SPT) varía de 10 a 13 golpes

Source: (CAMINOSCA C. LTDA., 2006)

Stratum 1	From 0.00 to 2.00 m Thickness: 2.00 m Description: Ballast backfill
Stratum 2	From 02.00 to 4.50 m Thickness: 1.50 m Description: Greenish clay with organic matter residues, very soft consistency, high plasticity. SUCS Classification: CH and OH Su from 0.9 to 0.30 t/m2
Stratum 3	From 4.50 to 5.50 m Thickness: 1.00 m Description: greenish-gray silt with strata of fine sand of medium consistency. SUCS Classification: ML
Stratum 4	From 5.50 to 6.50 m (end of drilling) Average thickness until the end of drilling: 1.00 m Description: medium compacted greenish gray silty fine sand SUCS classification: SM N (SPT) varies from 10 to 13 impacts

From a depth of approximately 5 m, the presence of sands is observed, which have a higher hydrocarbon infiltration rate, allowing for a greater depth of the contamination plume.

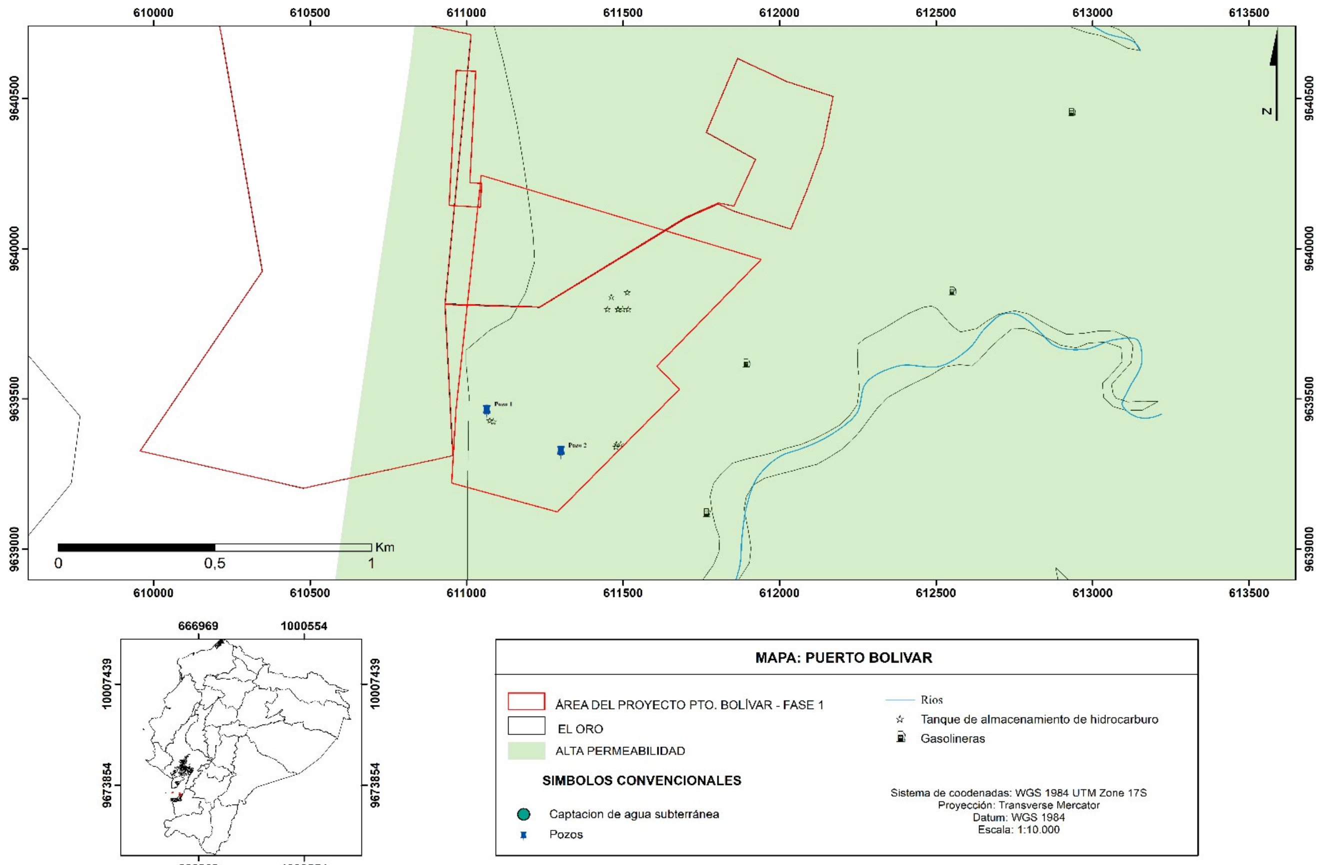
1.5.1.2 Sources of risk outside the project

Block 6 of Amistad field, located in the Gulf of Guayaquil, is the only source of free natural gas, and is processed in the natural gas dehydration plant located approximately 30 kilometers north of Puerto Bolivar, at the Bajo Alto site of Tendales parish, in El Guabo township, in the province of El Oro. This plant has identified a potential risk of affecting the soil resource due to condensate spillage from the Filter Separator, since the equipment does not have a cement platform to avoid direct contact with the soil in the event of a spill (Flores Sandoval & Siñalin Sevilla, 2013).

Other potential sources of contamination risk to the aquifer are the fuel storage facilities inside BINJAM and SUBSUR, and the fuel stations located in the Puerto Bolívar parish, both on land and on the body of water (Huaylá estuary).

The location of the identified potential sources of risk - both inside and outside the project site area - are shown in the Figure 5.

Figure 6 Risk infrastructures in the project's area of influence



Source: Yilportecu S.A.

Map: Puerto Bolivar	
Puerto Bolivar Project Area - Phase 1	Rivers
El Oro	Hydrocarbon storage tank
High Permeability	Gas stations
Conventional symbols	Coordinate system: WGS 1984 UTM Zone 17S Projection: Transverse Mercator Datum: WGS 1984 Scale: 1:10.000
Groundwater capture	
Wells	

Prepared by: Ecosambito, 2020

2. Environmental Studies

The records obtained, according to the principle of 'reasonably verifiable sources'[5], are:

- Environmental information
  - Environmental License No. MAE-RA-2017-309603 for the Project "CONSTRUCTION AND OPERATION OF THE PORT TERMINAL OF PUERTO BOLÍVAR, OPERATED BY YILPORT TERMINAL OPERATIONS YILPORTECU S.A.", issued by Resolution No. GADPEO-2018-009363-SUIA, of 03 April 2018, of the Provincial Government of El Oro.
  - Environmental License No. MAE-RA-2017-297974 for the Project "DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6, MANEOUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLÍVAR", issued by Resolution No. MAE-DPAEO-2017-009, December 19, 2017, of the Provincial Directorate of Environment of El Oro.
  - Environmental Registry No. 239660 for the project "CONSTRUCTION, OPERATION AND ABANDONMENT OF PIER # 6 OF THE PORT TERMINAL OF PUERTO BOLÍVAR", issued on December 16, 2019 by the Undersecretariat of Environmental Quality of the Ministry of Environment.
  - Hazardous Waste Generator Records, in force for each of the projects with environmental regularization detailed in the preceding numerals:
    - SUIA-10-2018-MAE-DPAE0-00440;
    - SUIA-11-2018-MAE-DPAEO-00446;
    - SUIA-03-2020-MAE-DPAEO-00699;

    and the respective Annual Declarations on Hazardous Waste Management for the years 2018 and 2019.
  - Waste Minimization Plans in force for each of the projects with environmental regularization detailed in the preceding numerals, and their respective Compliance Reports.
  - Environmental Compliance Audit, period December 2017-2018, of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6, MANEOUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLÍVAR", submitted by official letter YPTO-GG-0103-19 of 10 May 2019, and approved by official letter MAE-

[5] Record information that is reasonably ascertainable means (1) information that is publicly available, (2) information that can be obtained from its source within reasonable limits of time and cost, and (3) information that is practically reviewable. Translated from the original in English.

DPAEO-2020-0482-O of 27 February 2020 by the Provincial Directorate of El Oro of the Ministry of the Environment.

  - Environmental Compliance Audit, period April 2018-2019, of the Project "CONSTRUCTION AND OPERATION OF THE PORT TERMINAL OF PUERTO BOLÍVAR, OPERATED BY YILPORT TERMINAL OPERATIONS YILPORTECU S.A.", submitted by official filed letter YPTO-GG-0136-19 of June 24, 2019, and approved by official filed letter GADPEO-SGA-2020-0252-OF of January 03, 2020 by the Secretary of Environmental Management of the Provincial Government of El Oro.
  - Miscellaneous routine records and investigation reports of accidents involving the discharge of chemicals into soil and/or bodies of water.
  - Monitoring reports delivered monthly to MAAE and biannually to GADP El Oro, between December 2018 and September 2020.
  - Report on the stability and risk conditions of the walls of pool no. 2, conducted by SURCONSUL in October 2017.
  - Plans of implementation of port infrastructure.

- Historical usage information
  - Property Titles
  - Certificate of Ownership and Lien History
  - Permits and fees for local, regional, and national public entities.
- Other sources
  - Standard historical sources such as Ortho-photography, and relevant layers (.shp files) available in the National Information System Geoportal (SNI)[6], ministries, INEC and other public entities.
  - Interviews and surveys conducted with technical and administrative staff of YILPORTECU, APPB, Machala Fire Department, Parish Council of Puerto Bolivar, among others.

The analysis of the records obtained is carried out with considerations of accuracy and integrity of the information.

The purpose of the review of information provided by YILPORT is to obtain and review records that will help identify recognized environmental conditions in relation to the property.

[6] Available at https://sni.gob.ec/inicio

3. Identification of environmental liabilities

3.1 Introduction

For the identification of environmental liabilities, a Site Environmental Assessment (EAS, by its acronym in Spanish) has been carried out, which is an exhaustive review and investigation, aimed at knowing the environmental conditions that a site, property or terrain keeps, regarding its degree of pollution as a result of activities or operations carried out in it, through its history.

The EAS is the process of determining whether a particular property (including real estate and improvements) is subject to recognized environmental conditions, and is generally applicable to activities involving the storage of hazardous chemicals and subway storage/transportation of petroleum products.

This practice is intended to be used voluntarily by parties wishing to assess the environmental status of commercial real estate taking into account commonly known and *reasonably verifiable information* . The aim of this study is, through duly designed research, to identify recognized environmental conditions in relation to a property.

3.2 Methodology

This document constitutes the Environmental Assessment of the Site Phase 1 (EAS-F1) of the Puerto Bolivar Project - Phase 1 area, based on the *ASTM International Designation Technical Standard: E1527-13 "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process"* [7], adapted to the specificities of the area to be evaluated.

The minimum search distance will be that which covers the properties with Environmental Regularization in force in the name of YILPORT TERMINAL OPERATIONS.

3.3 Historical information about the site

3.3.1 Port activity

Puerto Bolívar was born as a port enclave at the end of the 19th century, Puerto Pilo was its first settlement -later called Puerto Machala- (between 1783 and 1860). Subsequently, due to the cocoa boom and the sedimentation of the Pilo estuary during the 19th century, the administration decided to create the Port of Huaylá́ (1861) in front of the island of Jambelí́, and in 1879 the pier was built and functioned until 1883. In this year Puerto Bolivar was inaugurated together with the railway - for the transport of wagons by animal traction - that would connect it with Machala; and in 1887 the construction of an iron pier with railway terminal and mobile crane was contracted. However, the site was already a logistic enclave

[7] Available at http://bennett-ea.com/wp-content/uploads/2014/01/E1527-13-Phase-I.pdf

among the former inhabitants who moved between the present territories of Guayaquil and Puná, productive and commercial enclaves, dedicated to barge construction and salt extraction. In the 20th century, in 1902, the operation of the Municipal Cabotage Pier (Muelle Municipal de Cabotaje) began which, together with the railway, became the first intermodal transport link between the provinces of El Oro and Guayas. In 1970, the Port Authority of Puerto Bolivar -APPB- was created, in charge of the administration of the international seaport, and from this point on, countless expansions and adjustments were made to increase berthing capacity (Tapia, 2017).

The area of the current Puerto Bolívar parish is a zone that has been highly intervened by human activities, mainly those related to port activities and logistics in general, shrimp farming, human settlements and fishing, all creating constant expansive pressure on land use, leaving only small areas of mangrove forests, to the detriment of coastal biodiversity.

In general, within the territories of Puerto Bolívar (Machala) and Jambelí (Santa Rosa), the coastal edge until the mid 1950's was still covered by thick mangrove forest vegetation with heights of up to 10 m that only gave way to estuaries, canals and savannahs. It was, until then, a site of abundant harvesting of shells, crabs, "jaibas" (crab pastry), mussels and oysters, as well as a nesting site for many seabirds (Coastal Resources Management Program, 1993).

The large amount of natural resources available in the estuary-mangrove system, as well as the strong demand for labor due to the production of monocultures -first cocoa, then bananas, and finally shrimp- has originated immigration phenomena throughout its history, resulting in the informal occupation of the banks of the Huaylá estuary and its flood zones (formerly the rural parish of Puerto Bolívar) until the entire available area was taken over and a single urban mass was consolidated with Machala (the urban parish), mainly from 1979, the year in which the hydraulic filling of the area was carried out (Gonzalez & Ochoa, 1993).

In 2016 by Administrative Resolution No. 31 -2016, delegated management of the Port Terminal is granted to YILPORT TERMINAL OPERATIONS. However, the property of Puerto Bolivar Port Terminal remains APPB, and YILPORTECU becomes the operator and administrator of the Port Terminal.

3.3.2 Evolution of land use

From the interviews conducted, and the review of historical information, publications, and photographic archive of APPB, a Timeline is established with the main activities carried out within the Port Terminal, in relation to the objective of this study.

Table 5 Timeline of the main milestones of the development of the Port Terminal

Year	Activity executed
1963	Construction of the breakwater Pier (No. 1 and No. 2)
1980	Construction of the marginal pier (No. 4 and No. 5)
1995	Construction of Cell 1
2000	Construction of the Yard No. 8
2008	Construction of Reservoir Tank 2 and elevated tank no. 2
2009	Construction of the Wastewater Treatment Plant (IMHOF Well)
2009	Separation networks AASS and AALL
2010	Paving of the Yard No. 9
2010	Construction of Well No. 2
2012	Construction of Well No. 5
2012	Construction of the electrical substation, fuel area and generators
2012	Paving of the Yard No. 8
2014	Construction of the Yard No. 10
2016	Administrative Resolution No. 31 -2016 - Delegated management to YILPORT TERMINAL OPERATIONS
2017	Rehabilitation of Buildings
2019	Rehabilitation of Warehouses
2019 - 2020	- Construction of the Cell Room and Electrical Wiring (from the main substation to the cell room and to pier 5) - Change of Rails in Pier 5
2020	• Construction of an effluent collector and grease trap in Yard No. 2 OROESTIBAS • Rehabilitation of the main roads, settlement areas, yards, pier 1 and access roads to the piers with asphalt within the Port Terminal. • Rehabilitation of Buildings

Source: Interviews with APPB and YILPORT staff
Prepared by: Ecosambito, 2020

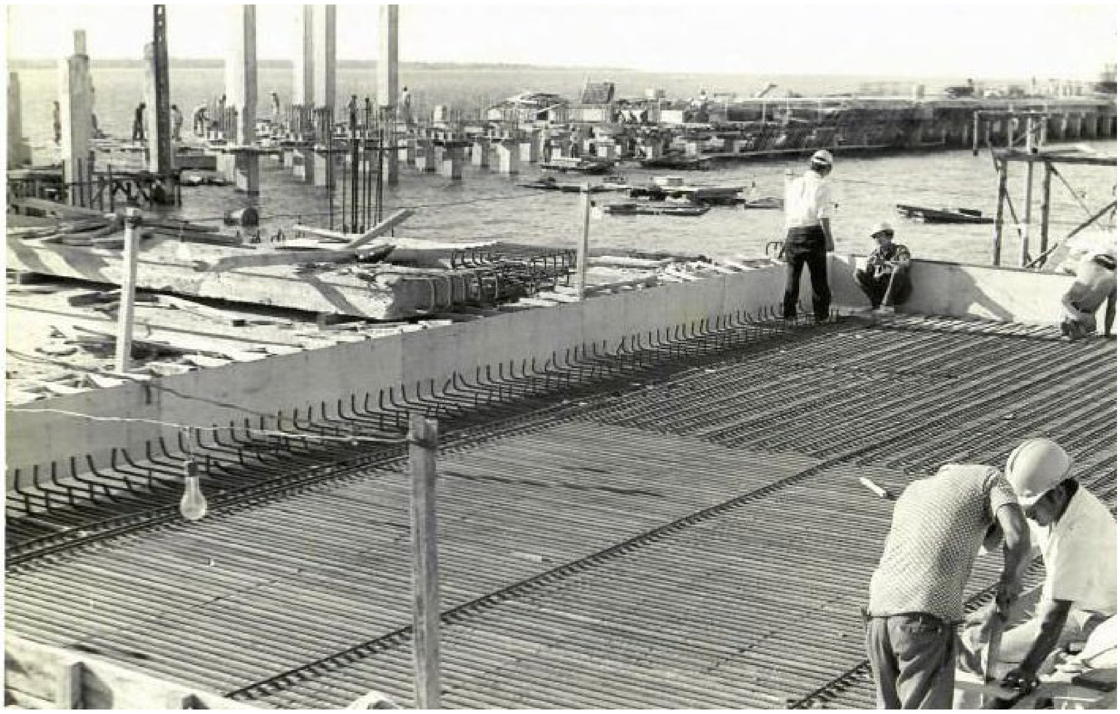
Moreover, the dredging that have been executed, are shown in the 6.

6 Dredging and Deposit Site History Table

Period	Dredged Volume (m^3)	Dredged Area	Deposit Area
July to October 1992	263,000.0	X	APPB Reservation Area
January-February 1996	182,000.0	X	APPB Reservation Area
November 1998 to February 1999	157,500.0	X	APPB Reservation Area
September to December 2000	121,000.0	X	APPB Reservation Area
February to July 2004	172,415.0	X	APPB Reservation Area
September 2008 to May 2009	284,263.0	X	APPB Reservation Area
March to May 2018	7,268,526.9	Access channel and maneuvering area	Offshore storage tank
April to May 2019	2,564,102.25	Access channel and maneuvering area	Offshore storage tank

Source: Yilportecu S.A.
Prepared by: Ecosambito, 2020

Photographic Record 1 APPB Photo Archive



Construction of the breakwater pier, year 1962

Construction of the marginal pier, year 1962

Construction of road work Av. 2nd Transversal, between current Yards No. 5 and No. 8, around the year 2000

Work for the consolidation of the current Yard area No. 10, year 2012.

Dumping of sediments dredged from the piers in the sediment ponds, between 2004 and 2009.

Source: APPB Photo Archive
Prepared by: Ecosambito, 2020

Photographic record 2. Infrastructure built in the last decade (2010-2020)

Electrical substation, built in 2012

Fuel area, built in 2012

Emergency generator room, built in 2012

Well No. 2, built in 2012

Source: Port terminal inspection of October 26, 2020.
Prepared by: Ecosambito, 2020

Photographic record 3.

Source: ECOSFERA 2017

3.3.3 Surrounding developments

Along with the port development, the parish was consolidating as a population and logistical center for the shrimp and artisanal and semi-industrial fishing sector, with more than 3,000 boat authorizations and 328 pier operating licenses in 2017 (100% occupation of the north bank of the Huaylá estuary). During this period, warehouses were also developed for the storage of various supplies for the aquaculture industry (food and chemical agents), ice factory, fuel and lubricant distributors, in addition to the shipment of machinery and construction materials -mainly by means of the barge that operates from the Yacht Club- and the transportation of personnel; as well as warehouses for the storage of bananas until their shipment for export. Tourist activities - mainly to the islands of Jambelí, del Amor and Santa Clara - and passenger transport to and from communities in the archipelago such as Costa Rica, Las Casitas, Las Huacas, Pongallillo, and others on the mainland coast such as Puerto Jelí and Puerto Pitahaya, are carried out from the cabotage dock of Puerto Bolívar, adjacent to the Port Terminal (Tapia, 2017, 25-34).

According to the chronicles of the time and the testimony of members of the Parish Council, until the end of the 1980s, there existed in Puerto Bolívar the CEPE[8] storage tanks on Olmedo Street (entrance to the 4 de Abril neighborhood, 600 m from the port terminal), which was supplied by means of an overhead pipe that ran along Av. Olmedo to the Santa Rosa estuary, fueling tankers that in turn supplied the fishing industry. CEPE had acquired an entire city block to strategically establish several tanks that contained: the largest containing 150,000 gallons of gasoline, a second holding 98,000 gallons of kerex, and a third large reservoir containing 150,000 gallons of diesel; in addition to other small tanks that stored *Fuel Oil*. This transportation of fuels by means of superimposed piping continually generated small leaks and spills, both on public roads (at the time, dirt roads) and in the Santa Rosa estuary, the site where the tankers were supplied. In 1987, a fire occurred in these tanks, which according to the testimony of a firefighter from the present time[9] during the incident, was started by accident when children in the sector played with fire near a puddle with discharges of stored hydrocarbons. The flames reached up to 60 m in height, and the surrounding population had to evacuate immediately, some even jumping into the waters of the Huaylá estuary. Finally, through an Act of Commitment between representatives of CEPE and residents of Puerto Bolivar, the definitive closure of CEPE's operations in the sector was agreed upon. However, there is no reliable record of the site's operations and closure conditions, since CEPE ceased to exist as a legal entity in 1989, and subsequently became Petroecuador.

Between February and March 1995, given the upsurge of shares in Upper Cenepa (yellow alert declaration), the Jambelí Naval Station (ESNAJA) was created in a small property delivered by APPB (former commissariat), where it operated until March 1996, when it moved to its new facilities (location and #243; n current), and it is in 2008 when he is designated as Marine Corps Battalion No. 22 “Jambelí” (BIMJAM), (Vargas Molina, 2014). The complex was built on the western margin of the Jambelí Naval Lyceum, between east and the coastline, on a high ground land surrounded by mangroves and shrimp pools.

In 2003, a 12.5-inch diameter pipeline was installed to transport natural gas offshore, linking the platform at Campo Amistad with Petroamazonas EP's facilities in the community of Bajo Alto (approximately 30 km north of the port terminal), to increase natural gas production by approximately ten (10) million cubic feet per day, with the incorporation of production from the AMSB-10 well, drilled by Petroamazonas EP.

North of BIMJAM, on the Puerto Cobre S.A. property (part of ECSA's mining project, and which will allow the shipment of the mineral concentrate extracted from the Mirador project in the province of Zamora Chinchipe to the Chinese market), a breakwater wall was erected

[8] Ecuadorian State Oil Corporation.

[9] Source: https://www.facebook.com/NoticiasElMachaleno/posts/3394247847266321/ consulted on 10/11/2020 at 16h00.

in 2015 to reinforce the existing structure (shrimp pool wall). Although the project has been licensed since 2007, no new intervention has been carried out on the site.

3.3.4 Previous environmental research

From the review of the archives detailed in section 2, and other publications, the following evidence was found related to research, study and/or analysis of infrastructure, operating conditions and environmental impacts:

- In the Ex-post Environmental Impact Assessment for obtaining the Environmental License for the project "CONSTRUCTION AND OPERATION OF THE PORT TERMINAL OF PUERTO BOLÍVAR, OPERATED BY YILPORT TERMINAL OPERATIONS YILPORTECU S.A." (ECOSFERA CIA.LTDA., 2017), the baseline of the project, the identification and assessment of environmental aspects and impacts, as well as the Environmental Management Plan are established. In this, the initiatives carried out by YILPORT to mitigate the environmental impacts generated by its operations are established among others. This document does not recognize any existing Environmental Liabilities or Environmental Condition.
- In the Environmental Impact Assessment for obtaining its Environmental License for the project "DREDGING OF THE PIERS 1, 2, 3, 4, 5 AND 6, MANEOUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLÍVAR" - elaborated by (ECOSFERA CIA.LTDA., 2017), the baseline of the project, the identification and evaluation of environmental aspects and impacts, as well as the Environmental Management Plan are established.
- The Environmental Audit of Compliance with the Environmental License for the project "CONSTRUCTION AND OPERATION OF THE PORT TERMINAL OF PUERTO BOLÍVAR, OPERATED BY YILPORT TERMINAL OPERATIONS YILPORTECU S.A." (ECOSAMBITO C.LTDA., 2019), where an average level of compliance with the evaluated criteria is established of 97.6%. This document sets out an action plan that includes the commitment to improve the order and management of hazardous wastes and effluents generated in the operations carried out in Yards No. 2 (OROESTIBAS) and No. 9 (ARETIN). To date, corrective action has been implemented in Yard No. 2, the action is pending in Yard No. 9.
- The Environmental Compliance Audit of the Environmental License for the project "DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6, MANEOUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLÍVAR" (ECOSAMBITO C.LTDA., 2019), where an average compliance level of 95.5% of the evaluated criteria is established; and where the established non-conformities are mainly linked to a change made in the dredging methodology, regarding the non-use of sediment ponds on land.
- And the Environmental Registry?

- Existing bibliography of heavy metal monitoring in sediments and biological species in the Santa Rosa estuary, among these: "Quantification of heavy metals in Anadara tuberculosa (*Mollusca: Bivalvia*) from the Huaylá estuary of Puerto Bolívar, by atomic absorption spectrophotometry" (Collaguazo, Ayala, & Machuca, 2017); "Evaluation of the distribution of total and bioavailable content of heavy metals: Cu, Cd, Pb and Hg in surface sediments of the Santa Rosa estuary, province of El Oro, Ecuador" (Senior, Valarezo, Yaguachi, & Marquez, 2015).

3.3.5 Administrative Processes

To date, the Ministry of the Environment has conducted 02 (two) administrative processes to Environmental License No. MAE-RA-2017-297974 for the Project “DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6, MANEOUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLÍVAR”.

1) Through Administrative Process No. 007-2018C.A., on September 19, 2018, the Provincial Directorate of the Environment of El Oro provides as a provisional preventive measure the order for the temporary suspension of activities in the execution of the dredging project; due to established breaches, associated with the use of 02 (two) TSHD dredgers instead of 01 (a), and partial submission of monitoring reports and non-compliance with some of the water and sediment quality parameters set out in the reference standards.
   By Filed document No. YPTO-GG-0309-18 dated October 1, 2018, YILPORT sends the disclaimer to Administrative Process No. 007-2018C.A.

   At a hearing held in Machala on 5 February 2019, the Administrative Procedure Sanctioning No. 007-2018C.A., in accordance with what is determined by Art. 213 and 244 of the Administrative Organic Code, rendering ineffective all actions within the administrative process No. 007- 2018C.A. and, the Temporary Suspension of Activities ordered in the execution of the Project “Dredging of Piers 1,2,3,4,5 and 6 of the Port Bolivar Maneuvering Area and Access Channel” was declared extinguished.

2) By Citation Ballot issued on February 18, 2019, the Provincial Directorate of the Environment of El Oro notifies Administrative Process No. 002-2019CA, for alleged breaches of the Environmental Management Plan and obligations established in the Environmental License.
   By Filed document No. YPTO-GG-0055-19 dated February 25, 2019, YILPORT sends the disclaimer to Administrative Process No. 002-2019C.A.
   At a hearing held in Machala, on March 19, 2019, everything acted on the basis of the initial order with which the administrative sanctioning procedure was initiated No. 002-2019C.A.

3.4 Environmental Monitoring

This section will analyze the historical results of the monitoring carried out between 2018 and 2020 of the respective Environmental Management Plans in force. See Annex 5 which includes Plan and Coordinates of Monitoring Points and Historical Monitoring Results.

3.4.1 Soil quality (seabed sediments)

Based on the results obtained in two years of soil quality monitoring of seafloor sediments carried out according to the Monitoring and Follow-up Plan (PMS) of the updated Environmental Management Plan in effect for the dredging project, the existence or absence of heavy metals (arsenic, cadmium, copper, total chromium, iron, mercury, lead), total petroleum hydrocarbons (TPH), and pesticides (organochlorine, organophosphorus, organonitrogen, and carbamates) is analyzed graphically. For pesticides, the result of highest value per type of pesticide or the total value by category is collected, depending on their availability (see Figure 7)

Analysis of results

From the historical results measured in the area of influence of the project, we have:

The Total Petroleum Hydrocarbons (TPH) parameter remains consistently below the MPL, with the exception of the baseline monitoring (conducted in May 2017) where all monitored points are well above the MPL, and in the monitoring conducted in May 2020 at point 7 (sediment pool on land) where a high value of the parameter associated with waste dumping by informal dwellers of the sector was detected.

The Arsenic parameter shows recurrently at all monitored points, values above Canadian regulations at all points (from P1 to P7), and above national regulations in points 1 and 2, however this behavior occurs interchangeably to whether or not dredging activities are carried out. In this regard, it should not be forgotten that arsenic can be found in groundwater inputs linked to natural geochemical processes, as a constant element in marine and estuarine waters, where contributions from continental waters and local variations in salinity and redox and temperature gradients can control the entry of arsenic from the mainland to the sea, and in drainage and leachates from mining activities (Lillo, 2005); is a component in arsenical pesticides (Reigart & Roberts, 1999); and that there is evidence of its accumulation in the seabed of the Santa Rosa estuary, as evidenced by the presence of arsenic by bioaccumulation in the "concha prieta" (Anadara tuberculosa) in the Huaylá estuary, which exceeds the limits established for consumption by Australian and New Zealand legislation (Collaguazo, Ayala, & Machuca, 2017).

A similar situation, although to a greater extent, occurs with the Copper parameter, where values above the Canadian and Ecuadorian standards are recurrently reported at all points, with large variations between the maximum and minimum values reported throughout the year, although it is observed that this behavior occurs regardless of whether or not dredging activities are carried out. In this regard, studies conducted on Evaluation of the distribution of total and bioavailable content of heavy metals, including copper, found that in the Santa Rosa estuary the concentration of copper ranged from 5.42 mg/kg to 39.17 mg/kg, with an average value of 21.85 mg/kg, of which bioavailable copper is on average 9.5% of total copper (Senior, Valarezo, Yaguachi, & Marquez, 2015).

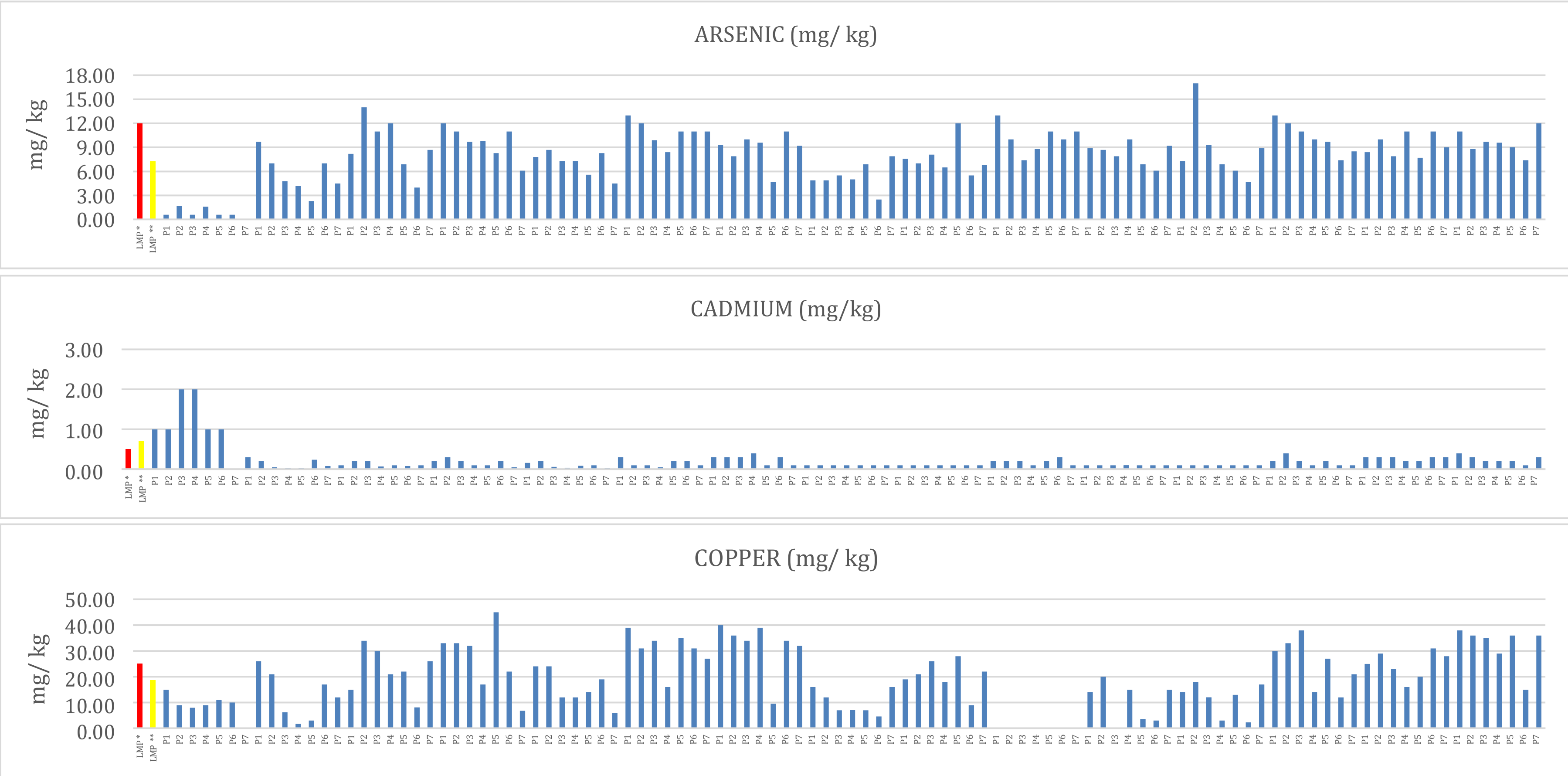
In the case of the Mercury parameter, the results of the analyses show accredited quantification limit values (< 0.1) coinciding with the MPL of the local regulations, so it is considered that it complies with the standard since, being a quantification limit value, we know that its exact concentration is below the value shown.

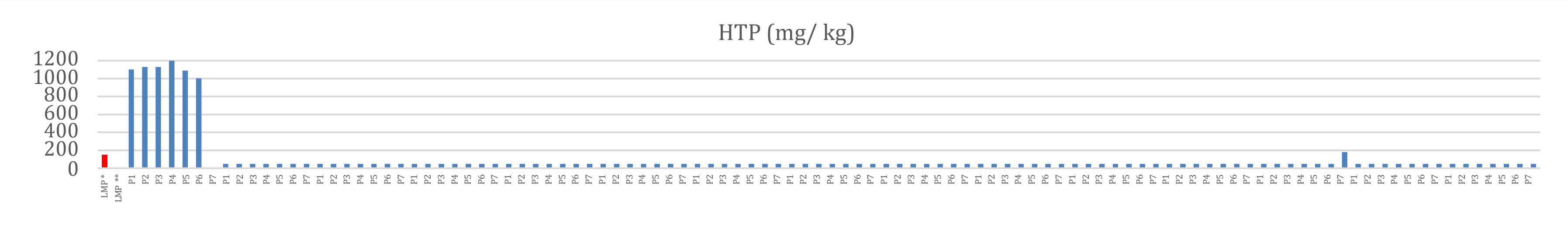
The parameters Cadmium, total Chromium, Lead, and Iron show a marked stability and in general remain below the MPLs of the standards evaluated - except for iron, which has no established MPL.

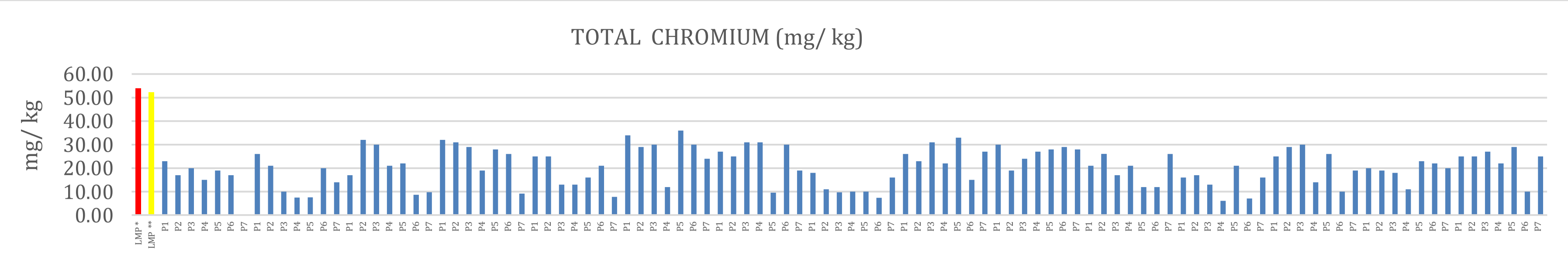
On the content of pesticides (organophosphates, organonitrogenates and carbamates, and all pesticides within these groups), their results appear as a constant value that corresponds to the accredited limit of quantification; and that do not exceed the MPL values when they exist.

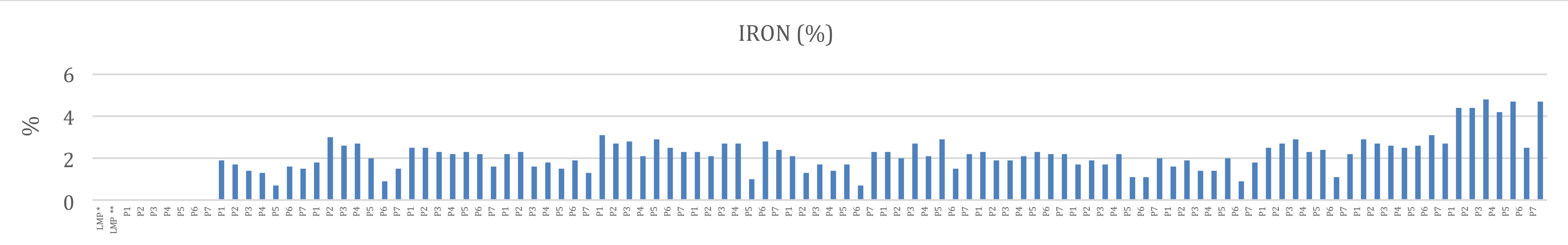
What was observed allows establishing that these results may be related to anthropogenic activities unrelated to dredging, given that the first dredging period was executed at the end of March 2018; among them aggregate and metallic mining, and which has an already reported impact on the sediment quality of the Santa Rosa estuary.

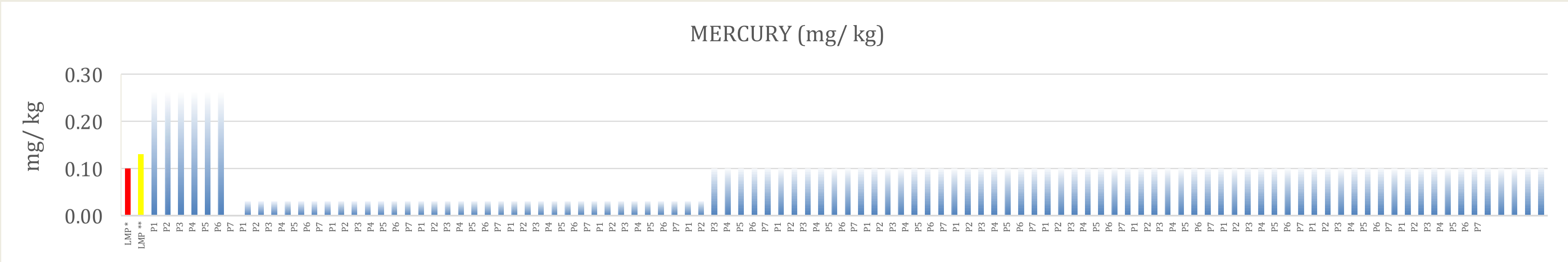
Figure 7 Historical results of soil quality parameters

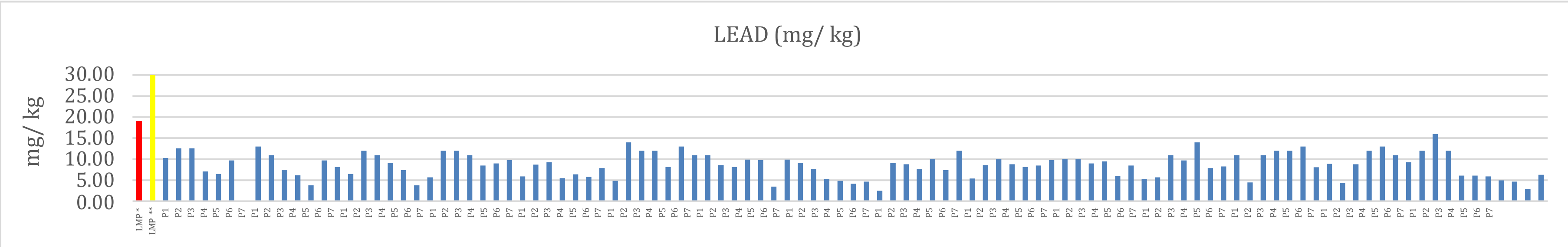


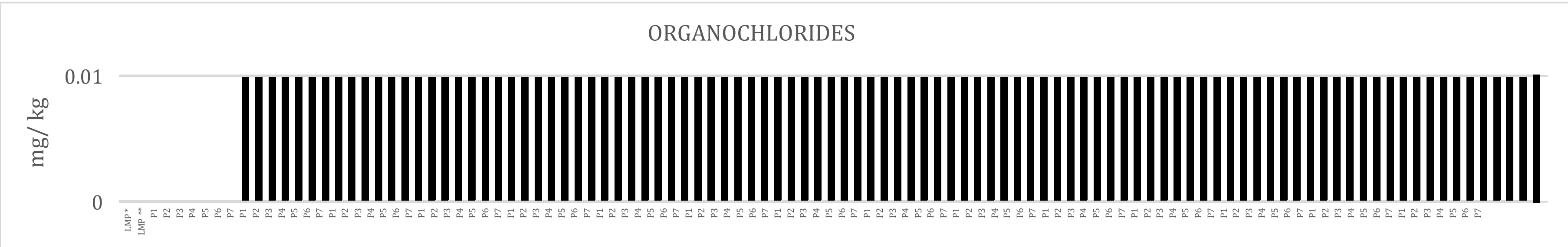

HTP (mg/ kg)
1200
1000
800
600
400
200
0
LMP *
LMP **

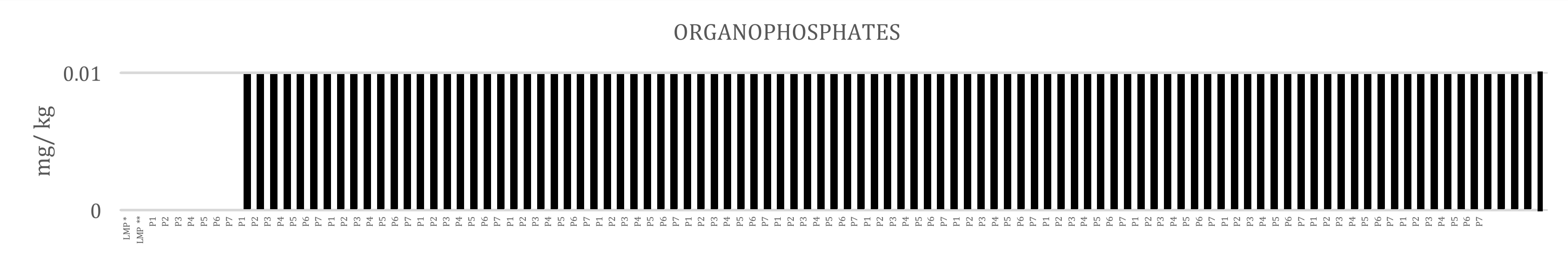

TOTAL CHROMIUM (mg/ kg)
mg/ kg
60.00
50.00
40.00
30.00
20.00
10.00
0.00
LMP *
LMP **

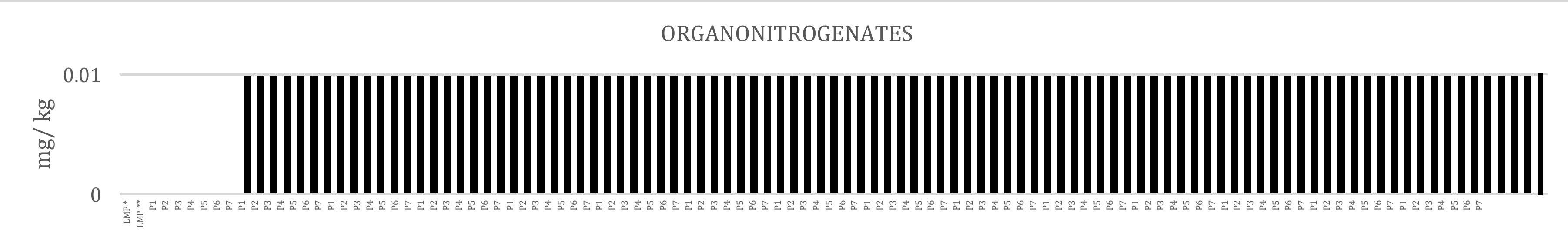

IRON (%)
%
6
4
2
0
LMP *
LMP **

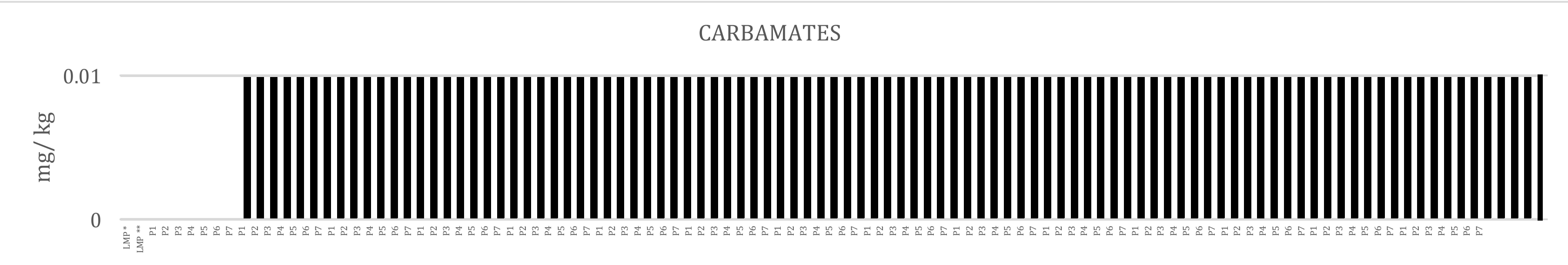

MERCURY (mg/ kg)
mg/ kg
0.30
0.20
0.10
0.00
LMP *
LMP **


LEAD (mg/ kg)
mg/ kg
30.00
25.00
20.00
15.00
10.00
5.00
0.00
LMP *
LMP **


ORGANOCHLORIDES
mg/ kg
0.01
0
LMP *
LMP **







** AM 097-A, Annex 2, Table 1: Soil Quality Criteria.*
*** Canadian Environmental Quality Guide Values for Water Bodies.*

ENVIRONMENTAL BASELINE_V2.

3.4.2 Dumping area

The richness and biological diversity of the marine flora and fauna of the dumping area has been monitored since 2018, with quarterly sampling of water, plankton and benthos, standardized fishing, and reports of sightings of marine mammals; establishing that the benthic community is the one that receives the greatest impacts when dredged sediments are deposited on top of it - burying the existing community - its recovery is achieved in about two months after dredging, so the level of diversity indicators H' of Shannon and Margalef did not decrease significantly, and fluctuations that would occur naturally within the bottoms of the dumping area are observed (Rebolledo Monsalve, 2020).

Water quality was assessed at baseline in April 2017, and water and sediment quality monitoring was conducted in December 2020 that included parameters Aliphatic non-chlorinated, Aliphatic chlorinated, BTEX (Benzene, Ethylbenzene, m+p Xylene, O-xylene, and Toluene) and Organotin Compounds (TBT).

Regarding water quality at the site, the results show that all parameters that have a defined maximum permissible limit comply with current regulations (Ministerial Agreement 097A, Annex 1: Environmental Quality Standard and Effluent Discharge to Water Resources, Table 2: Admissible Quality Criteria for the preservation of aquatic life and wildlife in fresh, marine and estuarine waters). Although in the case of the metals Copper, Iron, Mercury, and Lead (from the group of Total Metals), although the results obtained correspond to the "limit value of quantification" accredited by the laboratory, so we know that the real value is below this, it could not be established with certainty whether or not it complies with the regulations.
Regarding the quality of the sediments, the samples analyzed correspond to soils with an alkaline tendency (pH>7), and an organic matter content higher than 10%, in addition:

- Total Petroleum Hydrocarbons, metals Arsenic, Cadmium, Copper, Total Chromium, Tin, Mercury, Zinc and Lead are below the established maximum permissible limit; and Iron in normal concentrations for this environment.
- In the group of parameters of non-chlorinated aliphatics, BTEX, and aliphatic chlorinates, the results obtained are below the established maximum permissible limit.
- The content of the organochlorine pesticides Dieldrin, Endrin, Heptachlor, pp'DDE, pp'DDD, and pp'DDT, organophosphorus pesticides, organonitrogen pesticides and carbamates (and all pesticides within these groups), their results appear as a constant value that corresponds to the limit of quantification accredited by the laboratory.
- Tributyltin (TriButylTin) is reported as a value below the detection limit of 0.2 mg/kg. In the absence of a local standard setting MPL for TBT, and taking as reference values those proposed by the Dutch National Institute for Coastal and Marine Management (RIKZ) in their sediment quality guidelines, it is established that the TBT contained in the samples obtained far exceeds the reference maximum permissible limit. This excess indicates that the sediments in this area were highly contaminated by TBT, although at a much lower level than other monitored sites worldwide.
- The results obtained could be associated with dredging and sediment transport from the aprons of docks and maneuvering area of Puerto Bolivar, considering that in this port cleaning and painting of hulls have been carried out in a semi-artisanal way since the eighties of the last century and until 2017, when this activity was banned inside the Port Terminal.

3.4.3 Groundwater quality

Based on the results obtained in two years of monitoring water quality from Well No. 2 carried out by YILPORT's internal management, the existence or not of heavy metals (arsenic, cadmium, copper, total chromium, iron, mercury, lead), total petroleum hydrocarbons (TPH), and pesticides (organochlorine, organophosphorus, organonitrogen, and carbamates) is analyzed graphically. In the case of pesticides, the result of the highest value per type of pesticide or the total value per category, according to their availability, is shown (see Figure 8).

For the analysis of results, it should be considered that the regulations evaluated correspond to Ministerial Agreement 097A, Annex 1: Environmental Quality Standard and Discharge of Effluents to the Water Resource, Table 1: Quality Criteria of water sources for human and domestic consumption, i.e., it does not represent environmental quality parameters for groundwater.

Analysis of results

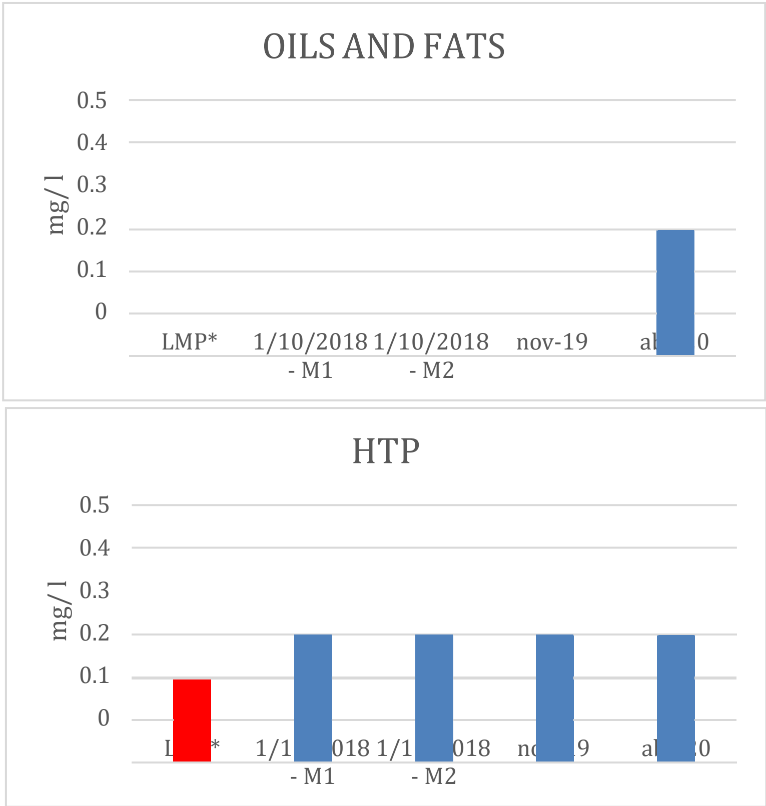
From the historical results measured in Well No. 2, we have:

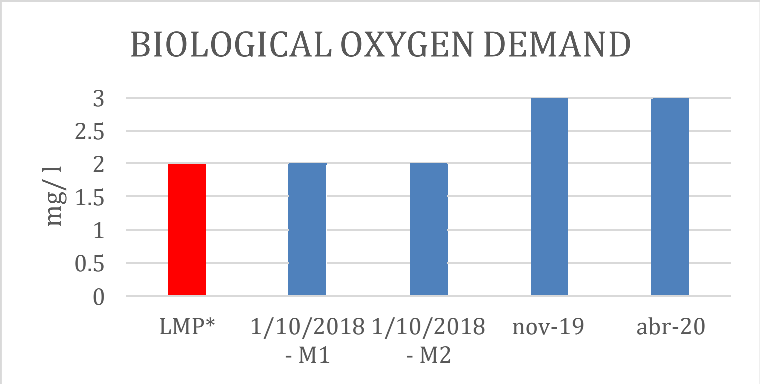
The Total Petroleum Hydrocarbons (TPH) parameter remains consistently above the maximum permissible limit, however, as these results are "accredited quantification limit values", it is considered that the actual value will be lower. In this case, the existence of petroleum hydrocarbon content of unknown origin in the aquifer is established, which, in general, may be the result of the following:

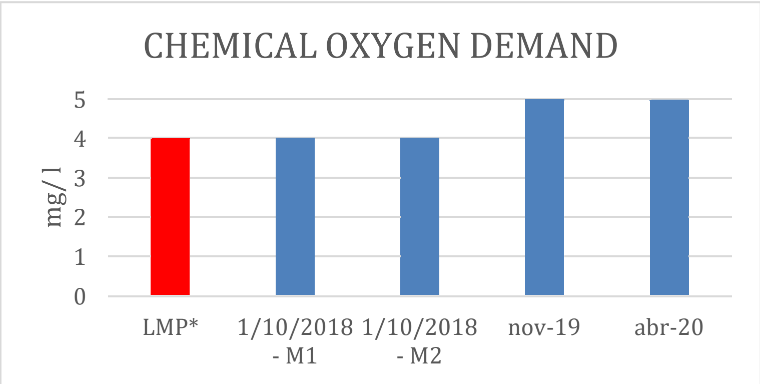
- Spills or leaks of toxic substances on the surface or in warehouses that subsequently infiltrate (oils and greases, wastewater, residues, chemicals, etc.).
- Hydrocarbons from leaking subway storage tanks or accidental spills.
- Inadequate maintenance of well extraction systems.

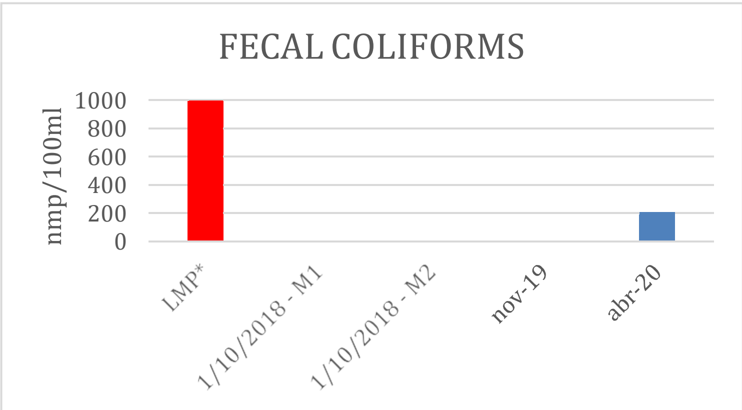
The BOD and COD parameters also oscillate between the maximum permissible limit and higher values, althoughagain they correspond to "accredited quantification limit values", so it is also considered thatthe real value will be lower.

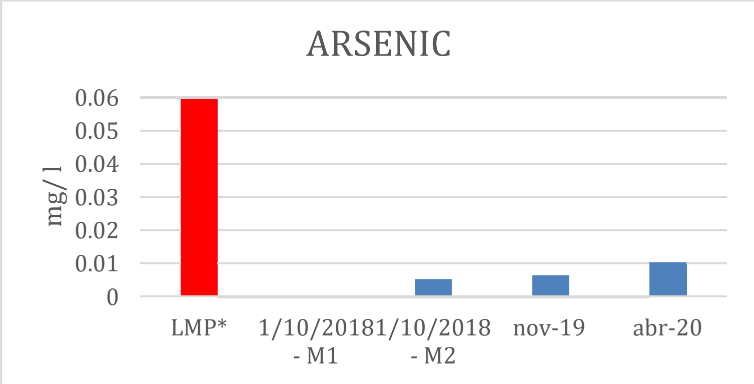
Figure 8 Historical results of water quality parameters for Well No. 2

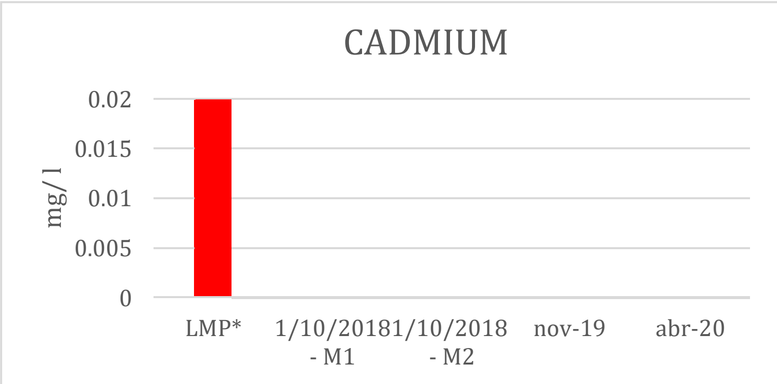


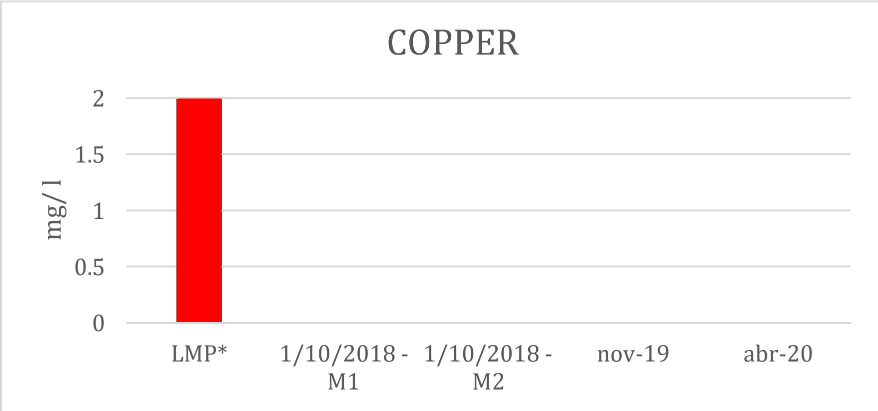

BIOLOGICAL OXYGEN DEMAND
mg/l
3
2.5
2
1.5
1
0.5
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

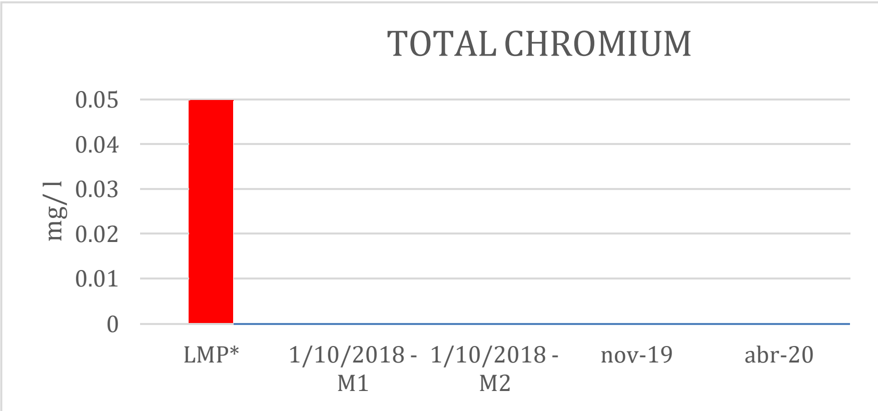

CHEMICAL OXYGEN DEMAND
mg/l
5
4
3
2
1
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

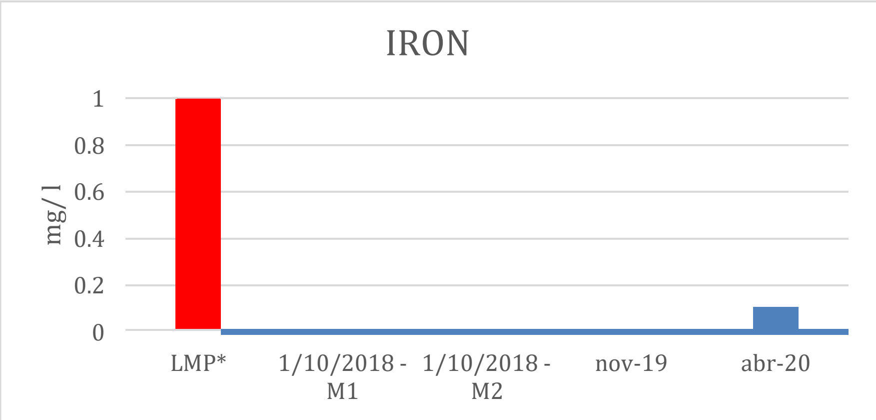

FECAL COLIFORMS
nmp/100ml
1000
800
600
400
200
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

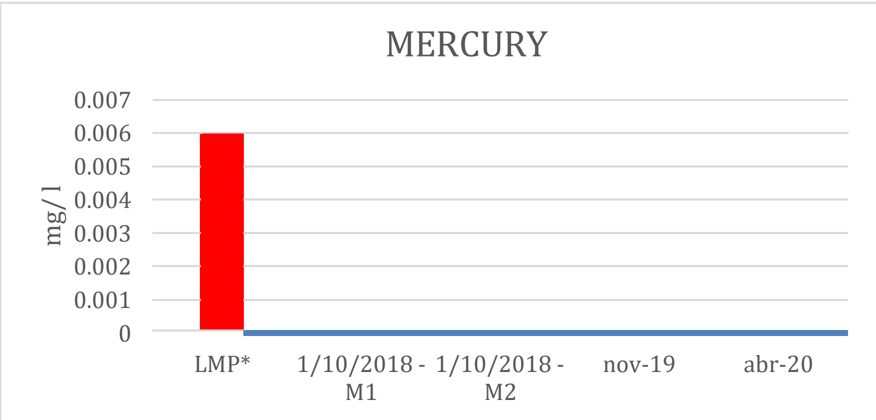

ARSENIC
mg/ l
0.06
0.05
0.04
0.03
0.02
0.01
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

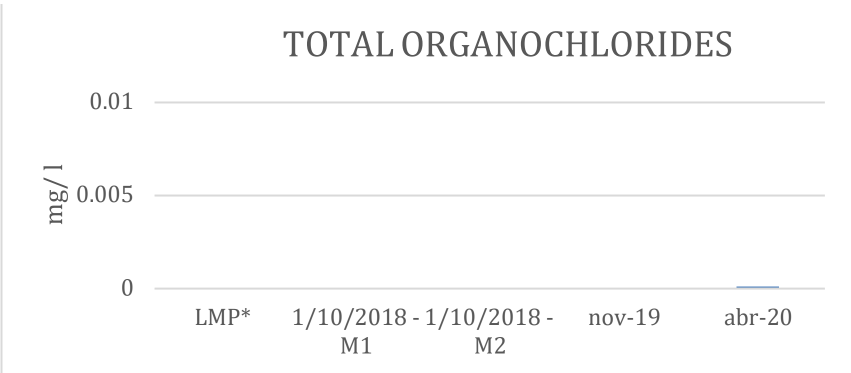

CADMIUM
mg/ l
0.02
0.015
0.01
0.005
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

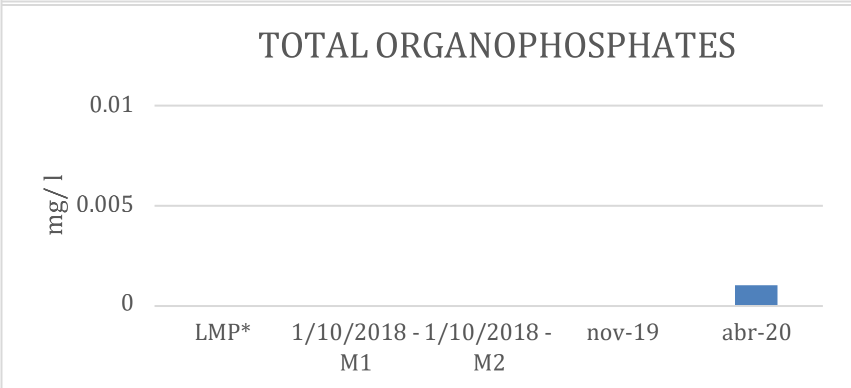

COPPER
mg/l
2
1.5
1
0.5
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

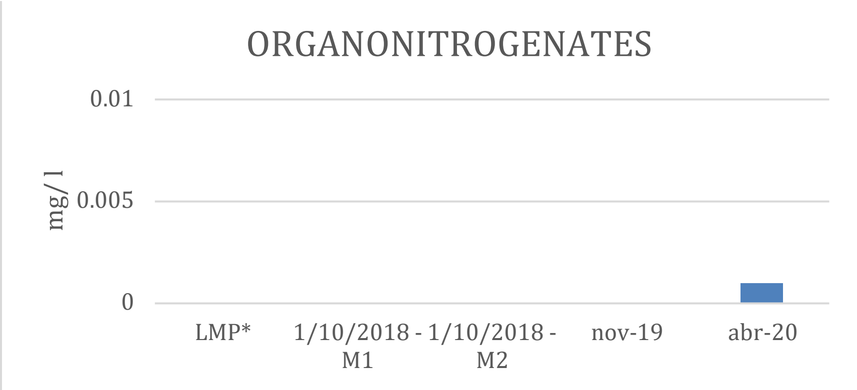

TOTAL CHROMIUM
mg/l
0.05
0.04
0.03
0.02
0.01
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20

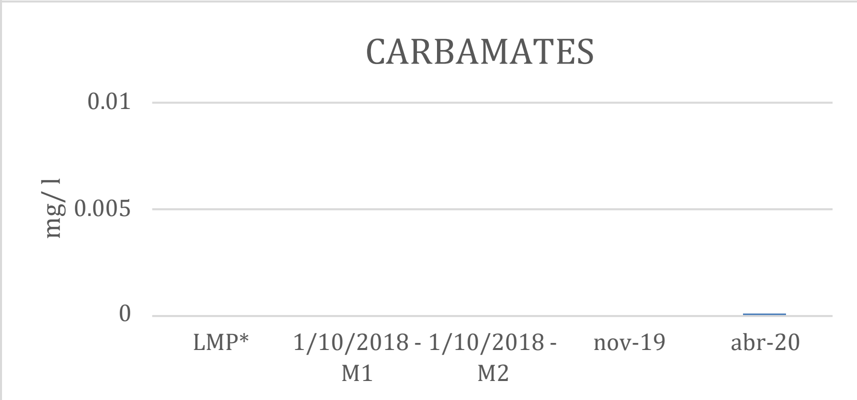

IRON
mg/l
1
0.8
0.6
0.4
0.2
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20


MERCURY
mg/l
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20


TOTAL ORGANOCHLORIDES
mg/l
0.01
0.005
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20


TOTAL ORGANOPHOSPHATES
mg/l
0.01
0.005
0
LMP*
1/10/2018 - M1
1/10/2018 - M2
nov-19
abr-20





** AM 097-A, Annex 1 Table 1: Quality Criteria for Water Sources for Human and Domestic Consumption*
Source: Yilportecu S.A.

Prepared by: Ecosambito, 2020

3.4.4 Air quality and noise

Air and noise quality in the project implementation area has been monitored for two years on a quarterly basis by Ecuadorian Accreditation Service (SAE, by its acronym in Spanish)-accredited laboratories, in accordance with the provisions of the Environmental Management Plans.

The air quality parameters measured are: Carbon Monoxide (CO), Nitrogen Oxides (NOx), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Ozone (O_3), Particulate Material $PM_{10}$and $PM_{2.5}$.

The air quality monitoring point is located at the APPB piers (610951, 9639819).

During this period of time, all measured parameters are below the Maximum Permissible Limits (Section 4.1.2 of Annex 4 of Book VI of the A.M. 097-A, that is, COMPLY with environmental regulations)

Ambient noise monitoring in the area of direct influence of the Project has been carried out with the same frequency as ambient air quality monitoring. The monitoring points are: Point 1. Pier #1 (610941, 9639369). Point 2. Administrative Area APPB (611136, 9639401) Point 3. Pier #5 (611014, 9640135) Point 4. Cabotage Pier Puerto Bolivar (610892, 9639050).

The results show that there are some points that exceed the permissible limits for land use (Ministerial Agreement 097-A, Annex 5: Maximum Noise Emission Levels and Measurement Methodology for Stationary and Mobile Sources, Table 1: Maximum E Levels).

Details of the monitoring results can be seen in detail in Annex V.

3.4.5 Biotic monitoring

An integral part of the Environmental Management Plan of the dredging project consists of the following monitoring:

PMS-06 MONITORING PROGRAM FOR PHYTOPLANKTON AND ZOOPLANKTON SPECIES

Phytoplankton and zooplankton quantities in the area of marine influence are monitored by taking samples. This resource is evaluated periodically, preferably on a quarterly basis. Measurement records will be kept and compared with the values obtained in the environmental baseline of the project. The monitoring frequency is quarterly.

PMS-07 MONITORING PROGRAM FOR BIOAQUATIC SPECIES

Monitoring of mollusks and crustaceans in mangrove zones located within the project's area of influence: - Vikingos del Mar Artisanal Fishing Production Cooperative - Estero Porteño Artisan Women's Association - La Playita Community Organization for Tourist Services. The monitoring frequency is quarterly.

PMS-08 FLORA AND FAUNA MONITORING PROGRAM

Monitoring of planktonic and benthic Flora and Fauna, sighting reports of marine mammals and ichthyofauna in the offshore deposition area, including a monitoring point at the Santa Clara Island Marine Reserve boundary. The monitoring frequency is quarterly.

Based on the results obtained in one year of monitoring (February 2019 — 2020), a Results Report was delivered to the Ministry of Environment (Annual Report - IC N° 002-2019-IC-FORAFAUNA-DPAEO-MAE)

Analysis of results

In terms of sestonic resources, it is observed that the pulses of zooplankton abundance in fractions greater than 300 and 500 microns — without a clearly defined pattern being observed — in the case of the fraction greater than 500 microns a greater winter abundance is observed, with a decrease corresponding to the development of dredging maneuvers, and a new peak of abundance after two months in the vicinity of Santa Clara Island as well as in the Santa Rosa estuary. This decrease cannot be attributed to dredging maneuvers, but rather, as these are resources that increase significantly in certain periods, they also show considerable decreases, with the lowest sestonic biomasses (mainly associated with zooplankton and ichthyoplankton) occurring during August and October 2019. The lowest zooplankton and ichthyofauna abundances occurred during the months of August and October 2019, corresponding to the summer period of the Ecuadorian coast.

Regarding benthic resources, it is observed that there is a greater richness of these in the Santa Clara station (offshore), which has mixed bottoms providing more habitats that allow the establishment of a greater number of species, while the stations within the dredge deposit tank (offshore) are of silt, mud and fine sands, being logical to have fewer differentiated forms of life in a much more homogeneous habitat. It is observed that, although the dredging maneuvers decreased the population and richness of benthic species, the Shannon's and Margalef's diversity index H' did not decrease significantly, showing fluctuations that would occur naturally within the bottoms of the tank.

Regarding the pedestrian extraction resources (bivalves and crustaceans), monitored in mangrove conservation areas within the Santa Rosa estuary, and adjacent to the Puerto Bolivar project implementation area, it is concluded that the extraction levels of bivalves in the Playita and Vikingos del Mar sectors are quite stable with respect to the fluctuations described in Isla del Amor. In the first two, it has been observed that in the samples taken during dredging maneuvers, more abundant collections have been achieved than in other samples, which is evidence that there is no effect in terms of bivalve abundance attributable to dredging activities. This non-affectation is corroborated by the size indicator (mean valvar diameter) of the exploited resources, which in the event of affectation, there should be - in subsequent sampling after dredging activities - smaller mean sizes, a situation that did not occur in any of the monitored areas.

3.4.6 Conclusions to the analysis of monitoring results

According to these results, it is established:

- The existence of heavy metals in the seabed of the Santa Rosa estuary, presumably from metal and aggregate mining activities upstream in the interior of the province, mainly in the townships of Machala, Santa Rosa, Zaruma and Portovelo;
- The existence of hydrocarbons in the pumping system of Well No. 2 or directly into the aquifer at 146 m deep. In this case, the existence of an infiltration of some type of hydrocarbon from the surface of the studied property cannot be ruled out, however, as seen in section 1.5 Risk Factors, there are a variety of possible sources of contamination (past and present) in the sector.
- ● The presence of TBT on the seafloor of the offshore sediment dumping area.
- There is no impact on the biodiversity surrounding the area where the project will be implemented.

3.5 Environmental permits or authorizations

The existing environmental authorizations correspond to those identified in Section 2. Information provided by YILPORT from this study.

In addition to the obligations to comply with the provisions of the applicable legal regulations and the conditions of the environmental licenses, as applicable, and the management plans in force, the EMP for the dredging project establishes that no sediment may be deposited in the offshore tank during the whale season (June 1 to October 31 of each year), this being the only specific restriction contained in the environmental authorizations in force.

3.6 Interviews

Interviews with stakeholders related to YILPORT and APPB management, industrial and environmental safety, public institutions and related social actors, is to obtain information or indications on the possible existence of recognized environmental conditions and/or environmental liabilities on the project sites.

In order to carry out this evaluation, an analysis of the main social stakeholders and institutions linked to the project, as well as YILPORT and APPB staff, was carried out in order to establish a list of relevant stakeholders according to their roles and the objectives of this evaluation, to whom they are conducted interviews, and are detailed in the Table 7.

Table 7. Interviews conducted

Name	Institution	Position	Date of interview
Tulio Jaramillo	MAAE	Environmental Quality Technician	5/11/2020
Alfonso Marín	MAAE	Environmental Quality Technician	5/11/2020
Freddy Aguilar	UPMA	First Sergeant	6/11/2020
Aída García	APPB	Chief Administrative Officer	22/10/2020
Vicente Arcentales	APPB	PIB MANAGER	22/10/2020
Henry Arévalo	APPB	Engineering Dept.	22/10/2020
Glenda Penaloza	APPB	Inventory of assets	22/10/2020
Héctor Vizueta	CPPB	Chairman	6/11/2020
Zoila Arias	CPPB	Secretary	6/11/2020

Belfo Alvarado		Inhabitant of Puerto Bolivar	6/11/2020
Hugo Ruilova	CBM	Chief (Commander)	17/11/2020
Antonio Coello	CBM	Second-in-command (Major)	17/11/2020
Santiago Aguilar	YILPORT	Project Manager	23/11/2020

MAAE, Ministry of Environment and Water
UPMA, Environmental Protection Unit - National Police
APPB, Port Authority of Puerto Bolivar
CPPB, Parish Council of Puerto Bolivar
CBM, Machala Fire Department
YILPORT, Yilport Terminal Operations

3.6.1 Conclusions of the interviews

From the interviews conducted, we obtained that:

- There have been no environmental incidents related to the spill of hydrocarbons within the assessed area (100% of responses), but only minor spills due to the loading and unloading of diesel into tanks and machinery.
- There have been no environmental incidents related to the burial of hazardous substances in soil (content or not) within the area evaluated (100% of responses).
- There have been no environmental incidents related to underground pipelines within the evaluated area (100% of responses).
- There have been no environmental incidents related to the deterioration of flora and/or fauna in the area of influence of the project (100% of the responses). This is, in addition to the construction of the Port Terminal and its consequent expansions, on previously populated territories of mangroves, "salitres", and associated fauna).

From these same interviews it is clear that, within the history of population and use of Puerto Bolivar (the parish), there have been some environmental incidents related to hydrocarbons, either due to the sinking of passenger transport vessels, minor spills during fuel loading in the Santa Rosa estuary and a large fire due to poor storage of hydrocarbons by CEPE (see section 5. 3 Surrounding Developments); and others such as the burial of a dead whale on the BINJAM beach (northeast neighbor of the port terminal) around the year 2000.

3.7 Site recognition

The purpose of site recognition is to obtain information indicating the likelihood of identifying recognized environmental conditions in relation to the property. Once the relevant zones within the area of interest have been established, through the review of aerial photography and site plans, a walking tour pattern is established to carry out a visual inspection of these sites, a photographic and geo-referenced record of the existing conditions - for this the best possible angle will be sought so as to record possible stains not visible at ground level, if possible from above or overhead (aerial) -, and an evaluation of the conditions found.

3.7.1 Relevant outdoor areas

The areas to be inspected outdoors are:

- Onshore sediment pools
- Access channel and Maneuvering Area in the Santa Rosa estuary
- Offshore sediment storage tank

Inspections of the Access channel and Maneuvering area in the Santa Rosa estuary were carried out between October 28 and November 8, 2020 by the ECOSAMBITO biological survey team.

The sediment pool was visited on November 9 at 11:50 am together with the sediment sampling team of GRUENTEC Laboratories.

The offshore sediment deposition tank could not be visited within the scope of this study, however the existing photographic record of biotic species monitoring conducted during 2019 and 2020 was reviewed, as well as the respective monitoring reports, with emphasis on bottom sediment sampling[10]. It should be noted that this site corresponds to a square of 2 km on one side at sea, where the seabed is located at a depth between 25 and 40 m.

3.7.2 Relevant indoor areas

The areas to be inspected indoors are:

- Fuel area
- Electrical Substation and Cell Room 1
- Yard 9 ARETINA
- Yard 2 OROESTIBAS
- Hydrocarbon storage tank area, Warehouse 12
- Hazardous Waste Collection Centre
- Cell 1
- Crane maintenance area, Pier 5
- Location area of *power-packs*, Pier 5
- Warehouses 1-6

3.7.3 Findings

The inspections were carried out during the tour of the specified sites, on October 26 and November 04, 2020, in the company of Industrial Safety and Maintenance technicians.

The specifications of the inspected facilities are shown in Table 1the, Photographic Record 1, Photographic record 2, Photographic record 4.

During the recognition of the property, the following elements were sought, which could indicate the potential presence of recognized environmental conditions in it:

[10] Carried out with a Van Been type dredge of 10 kg empty weight, 4 liters of sample capacity and 0.08 m^2 of impact surface with open mouth, during 10 sampling campaigns.

- **Hazardous substances and petroleum products in relation to identified uses:** Hazardous waste generation is largely used oils and adsorbent material impregnated with hydrocarbons, which in 2019 accounted for 71.23 per cent and 10.27% of the total generated respectively (ECOSAMBITO C.LTDA., 2020). Although the main hazardous wastes have been properly managed, there are still accumulations of special wastes (tires and rubber *fenders*, scrap metal) in areas of unsealed soils, as well as accumulations of common wastes on the coastline, which have arrived from the urban centers due to the effect of the tides.
- **Offensive odors:** In the sectors adjacent to the copper concentrate storage (30%), i.e. Warehouses 1 to 6, Yards 3 and 8, there is a strong and penetrating odor; however, this varies according to weather conditions (mainly in hours of intense sunlight or drizzle). Other odors perceived correspond to emissions of combustion gases from vehicles and loading machinery.
- **Liquid pools:** No pools containing liquids that may be hazardous substances or petroleum products were found.
- **Drums and hazardous substances, petroleum products and unidentified substances:** In the maintenance area (Warehouse 12) and the yards assigned to OROESTIBAS and ARETINA (2 and 9, respectively), there is storage of lubricating and hydraulic oils and greases in 55-gallon metal tanks, 20-liter buckets and 5-gallon drums, as well as used oils and greases (hazardous waste) in the respective storage tanks in each area described above. These areas also store - albeit in smaller quantities - refrigerant gas tanks and paints. In Cell 1 Collection Center, there are 55-gallon metal tanks with waste oils, adsorbent material impregnated with hydrocarbons, and used filters. Tanks containing liquid waste are located inside the existing concrete tank.
- **Heating and cooling source:** The air conditioning is made using air conditioner units (*compressor+split* unit) of a variety of sizes depending on the office, and a central unit in the training room. There is no heating system.
- **Interior stains or corrosion:** There are stains of moisture in various parts of the buildings, mainly those that have no use, since those that are occupied have been remodeled since 2018.
- **Drains and sinks:** Along the road axes are the collection wells of the wastewater system and leading to the PTAR; and in the corners next to the sidewalks, the sinks of the rainy water collection system.
- **Wells, ponds or lagoons:** Sediment pools constitute large empty ponds, which have not been used for sediment discharge since 2012. According to the structural analysis performed in 2017, it is concluded that "all the walls of pool No 2 are structurally stable" however, the use of the pools for the deposit of dredged material entails a series of risks, such as pipe breakage, water outflow force, stability of the surrounding walls, wall failure, inadequate or insufficient emptying and/or flooding, as well as the risk that exists due to the exposure of people adjacent to the project; which is why the pools are not used as a dumping area.

It is important to mention that to date no sediment disposal has been carried out in the area of the pools. In addition, the Complementary Environmental Study proceeds to the elimination of this area and the planned activity.

At present, the interior of pools 1, 2 and 3 are populated by an informal settlement that began at the end of August 2020.

- **Stained floors and pavements:** Hydrocarbon stains from dripping from machinery and vehicles operating inside the terminal are very common on the floors of the traffic lanes. The north sidewalk of Yard No. 9 is stained with traces of paints and hydrocarbons, effluents generated by ARETINA's operations.
- **Stressed Vegetation:** Although the port terminal is surrounded by areas with anthropogenic interventions, no areas of stressed vegetation were observed or reported on or adjacent to the property.
- **Solid waste:** The reserve areas and/or unpaved yards (Yards 7 and 14) are currently used for the disposal of debris, mainly from road repairs, although in small quantities in relation to the total area. It should be noted that these areas (Yards 7, 8, 9, 14, 14A) have been filled over the years up to 2012, with sediments from the dredging of the pier aprons (see 6 Dredging and Deposit Site History Table6).
- **Effluent:** The effluent collected by the sewage system is taken to the treatment plant, where it receives primary treatment by decanting and filtration with gravel, before being chlorinated and discharged into the breakwater area of the Santa Rosa estuary, at the height of Pier 4. The discharge complies with the MPLs established in Ministerial Agreement 097A, Annex 1: Environmental Quality Standard and Effluent Discharge to Water Resources, Table 10. Discharge limits to a marine water body, A) Discharge in a breaker zone. In Yard No. 2 There is a grease trap with a sand trap to pre-treat the effluent generated before it is discharged into the wastewater system.
- **Well:** The terminal has two wells authorized by Senagua, although Well 1 is currently collapsed and only water is obtained from well 2 (Table 1).
- **Septic systems:** No tanks or septic tanks were observed during the inspection carried out.
- **Other environmental considerations (asbestos-containing materials):** From a preliminary evaluation conducted by the YILPORT technical department, it is known that there are buildings (mainly warehouses and smaller buildings) whose roof is made of asbestos-containing fiber cement boards. However, these have been systematically replaced since 2017 according to needs for maintenance and remodeling of buildings. In total, there are about 21,000 m^2 of asbestos cement covers in operation.

Photographic record 4. Visual inspection

Yard 12 (behind the north end of Pier 5)

West Boundary of Yard 12

Front access to Fuel Area

Front access to Yard 1

Hazardous Waste Collection Centre Tank (Cell 1)

3.7.4 Limiting conditions

During the inspections, **NO** limiting conditions were found for the free observation of the Relevant Areas.

3.8 Previous evaluations

There are no environmental assessments of the site prior to the present study.

3.9 Limitations of the study

Considering that no environmental assessment or investigation is infallible, there will always be some degree of uncertainty regarding the presence or absence of recognized potential environmental conditions on the property under study, regardless of the rigor of the investigation. Consequently, ECOSAMBITO does not guarantee that Recognized Environmental Conditions, other than those identified in this report, do not exist on the subject property, or may not exist there in the future.

The findings and opinions presented in this report are based in part on information obtained from a variety of sources over which ECOSAMBITO has no control, but believes to be reliable. However, ECOSAMBITO does not guarantee the authenticity or reliability of information from these sources.

ECOSAMBITO believes that it has rendered the services summarized in this report in a manner consistent with the level of care and skill normally exercised by environmental professionals practicing at the same time and under similar conditions in the project area.

Conclusions about the status of the site do not represent a guarantee. Should new evidence or additional information become available after the date of this report, ECOSAMBITO is under no obligation to revise the conclusions and recommendations made in this report.

3.10 Environmental Conditions

3.10.1 Recognized Environmental Conditions (ERC, by its acronym in Spanish)

During the site inspection and tour, **NO** Recognized Environmental Conditions were identified within the facilities associated with the Project's activities, or outside its perimeter.

3.10.2 Historical Recognized Environmental Conditions (HREC)

Based on interviews, background documentary research, and water and sediment quality monitoring, **NO** Historical Recognized Environmental Conditions associated with Project activities were identified. However, the detection of TBT in the sediments at the bottom of the offshore basin gives us clues to the possible existence of tributyltin (TBT) in the bottom sediments of the docks and the maneuvering area.

3.10.3 Controlled Recognized Environmental Condition (CREC)

During the on-site inspection and tour, and interviews conducted and documentary background investigation, **No** Controlled Environmental Conditions were identified within the facilities associated with the Project's activities, or outside its perimeter.

3.11 Results and conclusions

Although it is concluded that the existence of environmental liabilities of any kind has not been established within the Port Terminal premises, it has not been possible to demonstrate the suitability of the fuel storage facilities (tanks, floors, spill containment tanks), due to the non-existence - within the scope of this evaluation and with the sources consulted - of Technical Memorandums and/or Delivery-Reception Acts of the same, nor of periodic evaluations of the integrity of the overlying steel tanks or of the semi-buried tanks.

It has been established that throughout the history of use of the Puerto Bolivar parish and the Santa Rosa estuary, there have been activities and events that could lead to the existence of environmental liabilities in the area of influence of the Project, and even in the sediments of the seabed of the Santa Rosa estuary, such as heavy metals, hydrocarbons, and TBT.

3.12 Recommendations

Perform an Environmental Site Assessment - Phase II (as defined for Standard Practice ASTM E1903 - 19), which includes assessments of the integrity of fuel storage tanks based on applicable technical standards, such as API 653 (Inspection, repair, modification and reconstruction of tanks), and API 575 (Inspection of atmospheric and low pressure tanks); as well as monitoring and measurements to establish the existence or not of an environmental liability in the subsurface.

TBT monitoring should also be conducted in the sediments of the Santa Rosa estuary to establish its presence and/or concentration.

3.13 Missing documentation and data

From the interviews, consultations and requests for information made to the APPB and YILPORT, it has not been possible to obtain the documents listed below:

- Technical report on the construction (if any) of fuel storage areas, tanks, effluent channeling systems, treatment plants, and others.
- Certificate of liens on the premises of the Port Authority of Puerto Bolivar.

4. Bibliography

C., C. C. (2006). *REPORT AND RESULTS OF FIELD RESEARCH.*

CAMINOSCA C. LTDA. (2006). *STUDIES OF APPB WASTEWATER TREATMENT SYSTEM.* Machala.

Colaguazo, Y., Ayala, H., & Machuca, G. (2017, September). Quantification of heavy metals in Anadara tuberculosa (Mollusca: bivalvia) from the Huaylá estuary of Puerto Bolívar, by atomic absorption spectrophotometry. *Science Magazine UNEMI*, 01-10. Retrieved November 11, 2019 from https://dialnet.unirioja.es/servlet/articulo?codigo=6430729

ECOSAMBITO C.LTDA. (2019). *ENVIRONMENTAL COMPLIANCE AUDIT OF THE PROJECT 'CONSTRUCTION AND OPERATION OF THE PORT TERMINAL OF PUERTO BOLIVAR, OPERATED BY YILPOR T TERMINAL OPERATIONS YILPOR T ECU S.A. ' - APRIL 2018 - 2019.*

ECOSAMBITO C.LTDA. (2019). *ENVIRONMENTAL COMPLIANCE AUDIT OF THE PROJECT DREDGING OF PIERS 1, 2, 3, 4, 5, 6, MANEOUVERING AREA AND ACCESS CHANNEL TO PUERTO BOLIVAR, - DECEMBER 2017 - 2018.*

ECOSAMBITO C.LTDA. (2020). *Annual Declaration of Hazardous Wastes 2019 - YILPORT SUIA-11-2018-MAE-DPAEO-00446.*

ECOSPHERE CIA.LTDA. (2017). *Environmental Impact Assessment (EIA) of the Project "Dredging of the Piers, Maneuvering Area and Access Channel of Puerto Bolivar".* ECOSPHERE CIA.LTDA.

ECOSPHERE CIA.LTDA. (2017). *Environmental Impact Assessment (EIA) for the "Construction and Operation of the Port Terminal".* ECOSPHERE CIA.LTDA.

ESPOL. (2014). *ELABORATION OF THE HYDROGEOLOGICAL MAP.* Guayaquil.

Flowers Sandoval, L. S., & Siñalin Seville, G. (2013). *INTEGRATION OF THE MACHALA NATURAL GAS DEHYDRATION PLANT IN MACHALA TO THE SCADA PLATFORM OF THE HYDROCARBONS MONITORING AND CONTROL CENTER (CMCH) FOR THE CONTROL AND SUPERVISION EXERCISED BY THE HYDROCARBONS REGULATION AND CONTROL AGENCY.* Quito.

JAMBELÍ PARISH Decentralized Autonomous Governments (GAD, by its acronym in Spanish) (2015). PLAN FOR THE DEVELOPMENT AND TERRITORIAL PLANNING OF JAMBELÍ.

Gonzalez, G., & Ochoa, E. (1993). *Urban Environmental Development of the Huayla Estuary, Machala, Ecuador.* NN.

INAMHI. (2015). *INTRODUCTION TO THE HYDROGEOLOGY OF THE EQUATOR.* Quito.

INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH. (2017). GEOLOGICAL SHEET MACHES.

INSTITUTE OF GEOLOGICAL AND ENERGY RESEARCH. (2018). GEOLOGICAL SHEET JAMBELÍ (PUERTO BOLIVAR).

Institute of geological and energy research. (1979). Geological sheet Machala.

Lillo, J. (2005). Geochemical hazards: arsenic of natural origin. Retrieved November 22, 2019 from https://www.ucm.es/data/cont/media/www/pag-15564/Peligros%20geoqu%C3%ADmicos%20del%20ars%C3%A9nico%20-%20Javier%20Lillo.pdf

Manzano Herrera, R., & Naranjo Calero, H. (2012). *HYDROGEOLOGICAL CHARACTERIZATION OF THE MACHAL UNIT".* Quito.

Ministry of Agriculture, Livestock, Aquaculture and Fisheries. (2015). *"SURVEY OF THEMATIC MAPPING SCALE".* Machala: ACOTECNIC - INGEOMATICA Association.

P., N. B. (2015). *INTRODUCTION TO THE HYDROGEOLOGY OF THE EQUATOR.* Quito.

Coastal Resource Management Program. (1993). *Management Plan of the ZEM Machala-Puerto Bolivar-Jambelí.* Guayaquil: Publication Funded by the United States Agency for International Development (USAID).

Reigart, J., & Roberts, J. (1999). Chapter 14. Arsenical pesticides. In J. Reigart, & J. Roberts, *RECOGNITION AND MANAGEMENT OF PESTICIDE POISONINGS* (pp. 140-151). Retrieved December 11, 2019 from https://espanol.epa.gov/sites/production-es/files/2015-09/documents/spch14.pdf

SENAGUA. (2014).

Senior, W., Valarezo, C., Yaguachi, A., & Marquez, A. (2015, December 15). EVALUATION OF THE DISTRIBUTION OF THE TOTAL AND BIOAVAILABLE CONTENT OF HEAVY METALS, CU, CD, PB AND HG IN SURFACE SEDIMENTS OF THE SANTA ROSA ESTUARY, PROVINCE OF EL ORO, ECUADOR. In *Book of the VII Ibero-American Forum on Coastal Resources and Aquaculture, VII FIRMA Ecuador 2014* (pp. 253-265). Machala, El Oro, Ecuador. doi: https://doi.org/10.31219/osf.io/knsyz

SURCONSUL. (2017). *3.1.5 PRJ-R133-SURCONSUL_Stability Conditions Report - Pool 2.*

Tapia, F. (2017). *Recovery of the Huaylá estuary in the city of Machala - Ecuador, through participatory back casting.* SUSTAINABILITY INSTITUTE - UNIVERSITAT POLITÈCNICA DE CATALUNYA. From http://hdl.handle.net/2117/108680

Varela, S. G. (2007). Final Report: Design monitoring against hydrocarbon spills.

Vargas Molina, J. G. (2014). *Summary History of the Ecuadorian Navy, Part II* (Vol. (II). (I. d. Maritime, Ed.) Institute of Maritime History of the Ecuadorian Navy (INHIMA). Retrieved November 20, 2020 from https://dokumen.tips/documents/historia-resumida-de-la-armada-del-ecuador-parte-ii.html

Vargas, E. L. (2002). Evaluation of the Jambelí Archipelago, Province of El Oro, as tourist offer.

5. Annexes

ANNEX 1. Legal ownership of the evaluated properties
ANNEX 2. Location map of the Puerto Bolívar Project — Phase 1
ANNEX 3. Geological Map of the Project Area
ANNEX 4. Hydrogeological Map of the Project Area
ANNEX 5. Plan of Monitoring Points and Monitoring Results
ANNEX 6. Employee Interview Model
ANNEX 7. Profile of the Environmental Professional who performs the EAS

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT, PUERTO BOLÍVAR PROJECT – PHASE 1

– MARINE-COASTAL BIODIVERSITY BASELINE –

Prepared for:

YILPORT TERMINAL OPERATIONS S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Table of Contents

Index of Figures

Executive Summary

The Puerto Bolívar project is mainly developed in the marine and coastal environment of the Tumbes Choco Magdalena ecoregion, one of the 34 global biodiversity hotspots–those sectors that concentrate more than 70% of the known life species in spaces that do not represent more than 1.4% of the world's surface.

The area of influence is an extensive estuarine and coastal marine system associated with the Guayas system, the largest watershed on the Pacific coast of South America that transports compounds of continental origin that fertilize this sector with depths not exceeding 90m to its mouth and receives an injection of oxygen supplied by the cold Humboldt current that comes from the south attached to the coast to this sector to deviate towards the Galapagos Islands. In terms of biological oceanography, these conditions constitute a favorable environment for multiple forms of life within which critical habitats are identified as remnants of mangrove forests that have mostly been transformed into shrimp ponds.

The richness of resources in the area of influence was estimated from secondary sources and the compilation of standardized samplings from the biological monitoring program defined in the document "Environmental Impact Study and Environmental Management Plan for the Dredging of Piers 1, 2, 3, 4, 5, 6 maneuvering zone and access channel of Puerto Bolivar", from which quantitative results of bimonthly monitoring between April 2018 and February 2020 were integrated.

When compiling the volume of sampling information, a disproportion between main sectors was observed, since of the 5 fixed analysis sites associated with dredging maneuvers; 4 were located offshore and included planktonic, benthic and captured or fished ichthyofauna analyses; while the sector closest to the dredging area, Estero Santa Rosa had only one sampling site next to Pier 1 of Puerto Bolivar Project and involved exclusively the planktonic community.

We chose to evaluate the infauna of soft-bottom beaches with samples from the interior of Estero Santa Rosa as well as the northern end of the area of influence and the southern end of the same plus Jambelí beach due to its practicality in collecting quantitative information that could be contrasted over time.

The integration of sampling yielded the presence of 191 phytoplankters, 59 zooplankters, 79 benthic beings of subtidal soft bottoms, 66 species of beach infauna and 81 fish captured within the area of influence, of which 8 ichthyofauna resources are considered vulnerable according to RedList and only one endangered species, the green turtle Chelonia mydas, was recorded.

1. Introduction

Biodiversity, a term coming from the words *"bios"* or life and "*diversitas"* or diversity, means the variability of living organisms from all sources, including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD, 1992)[1].

In simpler terms we can define biodiversity as the diversity of species that coexist in a given space and time and that represent an important environmental support and regulation service, since the functions performed by living beings integrate it in a given sector or site and its energy flows are generators of more forms of life and support other ecosystem services such as environmental regulation, also linking with resources that are exploited by man, constituting both as a provision of goods and cultural services.

Animal Biodiversity is higher in aquatic systems than in terrestrial ones. 34 of the 35 animal phyla known by science are aquatic and 50% of them are exclusively marine. Only one animal phylum is exclusively terrestrial. The estimated figures of different species are surprising; however, there is a practical way to classify all marine species based on their motility.

Animal biodiversity is higher in aquatic systems than in terrestrial systems: of the 35 animal phyllums known to science, 34 of them are aquatic, half of them exclusively marine, and only one animal phyllum is exclusive to terrestrial systems. The calculated numbers of different species are surprising, however, there is a practical way to classify all marine beings according to their motility and habitats in which they develop.

In this way we have the plankton or planktonic community, all those forms of life that float in the water column and with reduced capacity of movement with respect to the movement of the water, being dragged by the currents. Here we find two large groups: phytoplankton which corresponds to photosynthetic life forms and zooplankton which is the heterotrophic fraction (which requires consuming organic compounds to obtain energy), that is, they feed on other living beings. Size is not the best characteristic to discriminate these life forms, since they vary from microscopic beings to beings that exceed several meters in length.

In the opposite situation, the beings with the capacity for active movement that exceed the speed of water currents and that can move from one place to another in the water column are called nekton or nektonic community. Here its best known representatives are fish or ichthyofauna, however, other animal groups that are active swimmers include mollusks (octopuses and squid), crustaceans (shrimp, crabs) and higher vertebrates such as cetaceans, pinnipeds, reptiles and birds such as penguins, boobies and cormorants.

The third category is made up of animals that do not live in the water column, but are associated with bottoms, whether they are hard, such as rocks where they are cemented and can develop on submerged surfaces (biofouling) or are associated with soft bottoms, moving slowly over them or burying themselves in them (infauna). We call all these beings Benthos or benthic community.

[1] Convention on Biological Diversity

An interesting aspect of aquatic beings is that most of them may have initial stages of planktonic life, being larvae or eggs that will be disseminated by marine currents and the surface drag effect of the wind to later develop into benthic or nektonic life forms; We will call these beings mere planktonic and include marine invertebrate larvae as well as fish eggs and larvae (ichthyoplankton), while the life forms that integrate the plankton throughout their life cycle are called holoplanktonic.

The classification of marine life is broad, the mode of classification just described is functional and is mainly used for rapid sampling with specific equipment for each major group. However, once the samples are collected and arrive at a laboratory to proceed to the taxonomic identification of marine resources or marine life, they will be grouped according to taxa defined in the systematics, grouping them into Phyllums, Superclasses, Classes, Orders, Families, Genera and Species.

Many marine organisms are difficult to identify and in practical terms would require considerable periods of identification down to the genus or species level, considering that in complex groups it is acceptable to go as far as the family category. Table 1 presents the main phyllums of marine animals to facilitate the understanding of this report.

Table 1. Main Marine Animal Phyla. (Branch, 2001)

Phylum	Example	Phylum	Example
Porifera	Sponges	Platyhelminthes	Flatworms, planarias
Cnidaria	Corals and jellyfishes	Nemertea	Ribbon worms
Ctenophora	Comb jellies	Nematoda	Nematoda
Sipunculida	Peanut worms	Annelida	Polychaetes
Arthropoda	Crustaceans	Bryozoa	Bryozoans
Brachiopoda	Lamp shells	Mollusca	Clams, octopus, chitons, snails
Echinodermata	Urchins, sea cucumber, starfish	Chordata	Urochordata, Pisces, Mammalia
Priapulid	Priapulus	Chaetognata	Arrow worms

Prepared by: Ecosambito, 2020

As for plant species, size is the main general classification factor. Thus, we have microalgae (already described as phytoplankton) and macroalgae, with three main classes: green algae or Chlorophyta, brown algae or Phaeophyta, and red algae or Rhodophyta.

It is important to mention that taxonomic studies to describe the marine diversity are scarce in Ecuador. There are main groups without any description, it being necessary to resort to reference texts from other locations.

2. Methodology

In order to describe the marine-coastal biodiversity of the Puerto Bolívar Project's area of influence, three main activities were carried out:

- Search for general and sectoral bibliographic background.
- Compilation of the information gathered from 5 fixed monitoring points during the monitoring activities established in the EIA 2017; and
- Samplings to complete information on sites lacking information or analysis of general communities not included in the EIA 2017.

The reference texts used to study the marine-coastal biodiversity in the area of influence are listed below:

2.1 Phytoplankton

- *Acta Oceanográfica del Pacífico* (Oceanic Record of the Pacific), Volume 19, N.1, 2014 ISSN N° 1390-129X, of the Naval Oceanographic Institute of Ecuador (INCOAR in Spanish), which contains descriptions of diatoms, silicoflagellates and coccolithophorids of the phytoplankton in the Gulf of Guayaquil, by Roberto Jiménez; dinoflagellates of the phytoplankton in the Gulf of Guayaquil, by Flor Pesantes, and tintinnids in the Gulf of Guayaquil, by Iván Zambrano
- Identifying Marine Diatoms and Dinoflagellates. Carmelo R. Tomas, Grethe R. Hasle, Karen A. Steidinger, Erick, E. Syvertsen, Karl Jangen, 1995. Academic Press, Inc.
- The "algaebase" digital database[2].
- Phytoplankton identification, Kudela Lab Biological Oceanography, University of California Santa Cruz. http://oceandatacenter.ucsc.edu

2.2 Zooplankton:

- Naval Oceanographic Institute of Ecuador (INCOAR in Spanish). Oceanic Record of the Pacific, Volume 2, N° 2, 1983:
- Tintinnids in the Gulf of Guayaquil, Iván Zambrano
- *Estudio taxonómico de los Quetognatos del Golfo de Ecuador* (Taxonomic Study of Chaetognatha in the Gulf of Ecuador), Dolores Bonilla A.
- *Pteropodos y Heterópodos del golfo de Guayaquil* (Pteropods and Heteropods in the Gulf of Guayaquil), Helena Gualancanay
- Demetrio Boltovkoy, 1981. *Atlas del zooplancton del atlántico sudoccidental y métodos de trabajo con el zooplancton marino* (Zooplankton Atlas of the Southwest Atlantic Ocean and Methods to Work with Marine Zooplankton).
- Robert D. Barnes, 1983. *Zoología de los invertebrados* (Zoology of Invertebrates). Editorial Limusa, México D.F.

[2] www.algaebase.org

- H. Geoffrey Moser, 1996.The early stages of fishes in the California current region, Atlas N° 33. National Marine Fisheries Service. Southwest Fisheries Science Center La Jolla, California.
- Luzuriaga-Villarreal María, 2015. *Distribución del ictioplancton y su interrelación con parámetros bióticos y abióticos en aguas costeras ecuatorianas* (Ichthyoplankton Distribution and its Interrelationship with Biotic and Abiotic Parameters in Ecuadorian Coastal Waters). In: Oceanographic Record of the Pacific, Vol. 20, Nº 1, 2015. Naval Oceanographic Institute of Ecuador (INOCAR in Spanish).

2.3 Benthic Community:

- Brito Vera Maria José and Elba Mora Sánchez, 2017. *Moluscos marinos distribuidos en la primera milla de la costa ecuatoriana* (Marine Mollusks distributed in the First Mile of the Ecuadorian Coast). National Fishing Institute (INP in Spanish), Ministry of Aquaculture and Fisheries.
- Myra A. Keen, 1971. Sea tropical Shells of Western America. Stanford University Press.
- De León-González et al., 2009. *Poliquetos (Annelida: Polychaeta) de México y América Tropical* [Polychaeta (Annelida: Polychaeta) of Mexico and Tropical America].
- FAO Species Identification Guide for Fishery Purposes, Western Central Pacific, 1995. Volume 1. Marine Algae and Invertebrates.
- Oceanographic Record of the Pacific, Volume 19, N.1, 2014 ISSN N° 1390-129X, of the Naval Oceanographic Institute of Ecuador (INOCAR in Spanish), Bivalves of the Gulf of Guayaquil.
- The “World Register of Marine Species WoRMS[3]” digital database.
- The “Catalogue of Life[4]” digital base
- Ángel de León, 2017. *Estado del conocimiento de poliquetos en el Ecuador* (State of Knowledge of Polychaeta in Ecuador). In: Díaz-Díaz, O., D. Bone, C.T. Rodríguez & V.H. Delgado-Blas (Eds.) 2017. *Poliquetos de Sudamérica* (Polychaeta in South America). Special Volume of the Newsletter of the Oceanographic Institute of Venezuela. Cumaná, Venezuela, 149 pp.
- Francisco Villamar, 2013. *Estudio de los poliquetos (gusanos marinos) en la zona intermareal y submareal de la bahía de manta (ecuador), y su relación con algunos factores ambientales, durante marzo y agosto del 2011* [Study of Polychaeta (marine worms) in the intertidal and subtidal zone of Manta Bay (Ecuador) and their Interrelationship with some Environmental Factors, during March and August 2011]. Oceanographic Record of the Pacific, Vol. 18, Nº 1, 2013.

[3] http://www.marinespecies.org/

[4] http://www.catalogoflife.org/

2.4 Ichthyofauna

- FAO Species Identification Guide for Fishery Purposes, Western Central Pacific, 1995. Volumes 2 and 3. Marine Fish and Mammals.
- Herrera M., Saa I., Ferreyros S., Coello D., and Solís-Coello, P. 2017. *Peces del perfil costero ecuatoriano: primera milla náutica* (Fishes of the Ecuadorian Coastal Profile: First Nautical Mile). National Fishing Institute (INP in Spanish), 453 pp. Guayaquil-Ecuador.
- Jiménez Prado P. and P. Bearez, 2004. *Peces marinos del Ecuador Continental* (Marine Fishes of Continental Ecuador), SIMBIOE/NAZCA/IFEA, Volume 1. Quito.
- Martinez Ortiz J. & Garcia-Dominguez M. 2013. *Guia de campo condrictios del Ecuador. Quimeras, Tiburones y Rayas* (Chondrichthyes of Ecuador Field Guide. Chimaeras, Sharks and Rays). Martinez-Ortiz J. (ed). Ministry of Agriculture, Livestock, Aquaculture and Fisheries (MAGAP in Spanish) / Vice-Ministry of Aquaculture and Fisheries (VMAP in Spanish) / Under Secretariat for Fishery Resources (SRP in Spanish). 246 pp.
- The www.fishbase.org digital base[5].

2.5 Seabirds

- Robert S. Ridgely y Paul J. Greenfield. *Aves del Ecuador* (Ecuadorian Birds), Volume 1. Academy of Natural Sciences of Philadelphia and Jocotoco Conservation Foundation.
- Orihuela-Torres Adrián, Fausto Lopez-Rodriguez and Leonardo Ordoñez Delgado 2016. *50 aves comunes del archipiélago de Jambelí* (50 Common Birds in Jambelí Archipelago). Research Group on Governance, Biodiversity and Protected Areas. Universidad Técnica Particular de Loja.

2.6 Marine mammals and reptiles

- Fischer, W., Krupp F., Schneider W., Sommer C., Carpenter K.E., and V.H. Niem (1995). FAO Guide to the Identification of Species for Fisheries Purposes. Eastern Central Pacific. Volume III. Vertebrates Food and Agriculture Organization of the United Nations.
- The digital database of The whales and dolphins Conservation Society, https://uk.whales.org/whales-dolphins/species-guide/

Sampling information collected in monitoring carried out during the period 2018 - 200 is shown in Table 2, and that of the latest sampling carried out in Table 3.

[5] https://www.fishbase.se/search.php

Table 2. Samplings analyzed in the 2018-2020 Period

Main Biological Group	Analyzed Sites	Samples per Site	Total Samples	Sampling Method
Phytoplankton	5	14	840	Sample acquired at 3 depths per site with van Dorn Bottle, Utermohl analysis method
Zooplankton, fraction > 300 microns	5	1	60	Trawling with a 300-micron net for 3 minutes
Zooplankton, fraction > 500 microns	5	1	55	Trawling with a 300-micron net for 3 minutes
Benthic community	4	1	48	Sample acquired with a 10-kg Van Veen dredge and sieved through a 500-micron sieve
Fish	4	1	48	30-minute fishing with 3.5” nets and two cloths
Infauna	4	8	32	Manual collection at stations distributed along the intertidal elevation gradient with shovel support on reference beaches in the area of influence
Benthic community	9	1	9	Sample acquired with a 10-kg Van Veen dredge and sieved through a 500-micron sieve in the Santa Rosa estuary

Prepared by: Ecosambito, 2020

It is worth mentioning that in all the navigation trips made from Puerto Bolivar to Santa Clara Island during sampling, each crew member became an observer of protected marine life, when sightings occurred, the boat was slowly guided towards the protected species in question, geo-referencing the observation sites and describing the species observed, as well as its main activity.

Table 3. Samplings made in November 2020

Main Biological Group	Number of Analyzed Sites	Number of Samples Acquired per Site	Total Analyzed Samples	Sampling Method
Infauna	4	8	32	Manual collection from shovel-dug holes distributed along the vertical intertidal gradient of the beach analyzed
Benthic community	9	1	9	Sample acquired with a 10-kg Van Veen dredge and sieved through a 500-micron sieve in the Santa Rosa estuary
Fish	2	1	2	20-minute fishing with 8 2 ¾“ panels in the Santa Rosa Estuary, enclosure type “pens”

Prepared by: Ecosambito, 2020.

The description of seabirds was exclusively based on secondary sources, extracting information from previous projects executed in the intervention.

The descriptors selected to quantify the diversity obtained from records in the area are as follows:

1) Species richness
2) Abundance of individuals collected
3) Shannon H´ diversity index
4) Margalef diversity index

3. Results

3.1 Phytoplanktonic Community

The monitoring carried out from April 2018 to February 2020 recorded 197 different phytoplankters in the study area. Diatoms or Phyllum Bacillariophyta are the most abundant group with 123 species, followed by Phyllum Myozoa with 43 species, protozoa with 14 species, Cyanophyta with 10 species and Phyllum Charophyta with only one species. The abundance base of recorded species is attached as an annexed document and it should be noted that Phytoplanktonic beings are not categorized within RedList, being considered NA or Not assigned.

Despite this high richness of microalgae, 20 main species represented more than 80% of the total microalgae abundance, which are listed in Table 4. In this table, the Phyllum Cyanophyta species (cyanobacteria) are highlighted in light green and Dinoflagellates are highlighted in salmon. Figure 1 and Figure 2 show the total microalgae abundance, considering all monitoring and samples acquired and the evolution of abundance and sectoral distribution of microalgae for the same period.

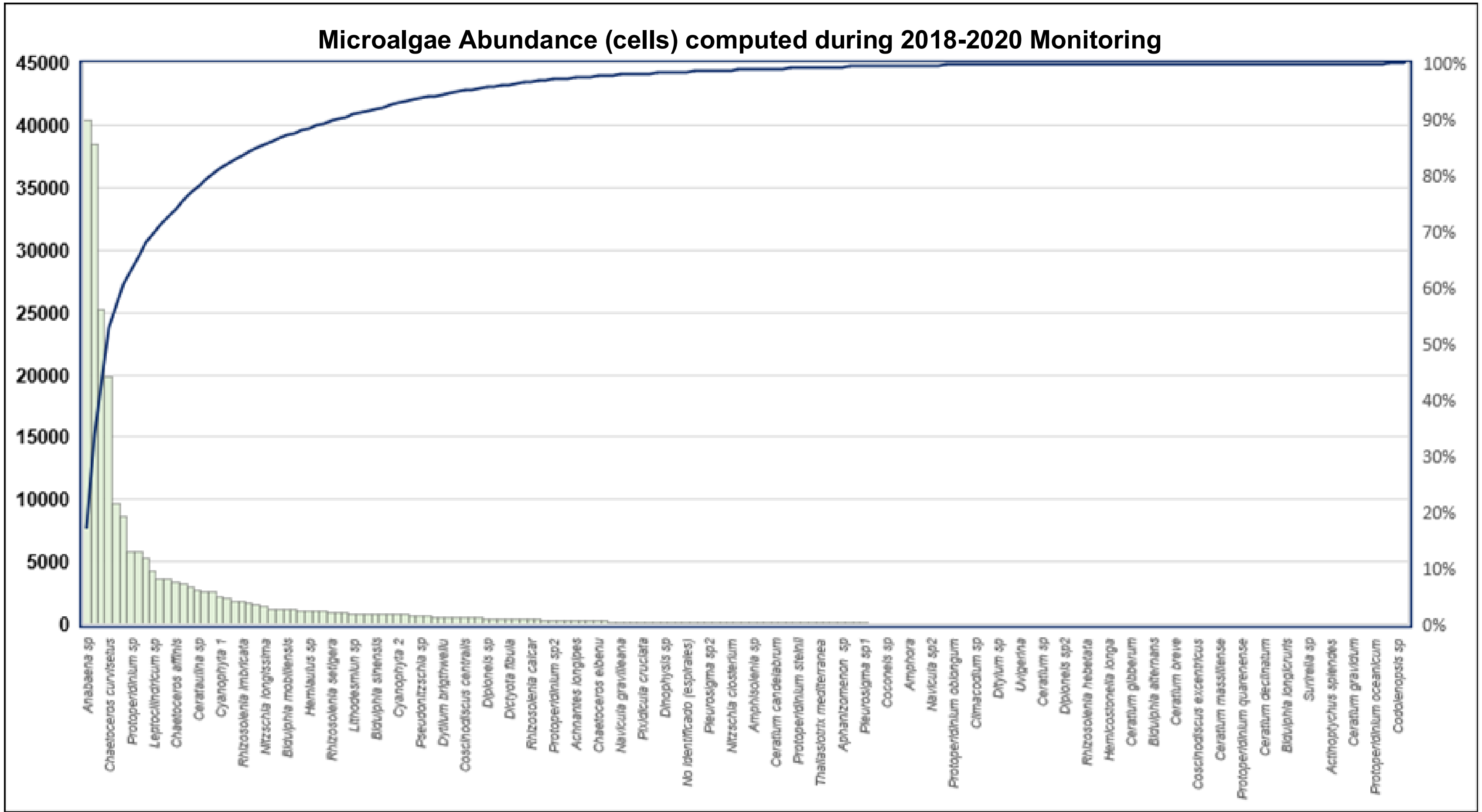
Table 4. Top 20 Phytoplankton Species for the 2018 – 2020 Period

Abundance Ranking	Genus/Species	Relative Abundance
1	*Anabaena sp*	17.27%
2	*Skeletonema costatum*	16.47%
3	*Thallasiosira subtilis*	10.77%
4	*Chaetoceros curvisetus*	8.47%
5	*Lauderia sp*	4.10%
6	*Nitzschia pungens*	3.68%
7	*Protoperidinium sp*	2.47%
8	*Bacteriastrum elegans*	2.45%
9	*Guinardia sp*	2.28%
10	*Leptocilindricum sp*	1.79%
11	*Bacteriastrum hyalinum*	1.53%
12	*Thallasionema nitzschoides*	1,52%
13	*Chaetoceros affinis*	1.44%
14	*Coscinodiscus granu*	1.39%
15	*Chaetoceros costatus*	1.27%
16	*Cerataulina sp*	1.15%
17	*Coscinosira polychorda*	1.12%
18	*Cyanophyta 1*	0.92%
19	*Coscinodiscus radiatus*	0.91%
20	*Coscinodiscus granii*	0.79%

Prepared by: Ecosambito, 2020

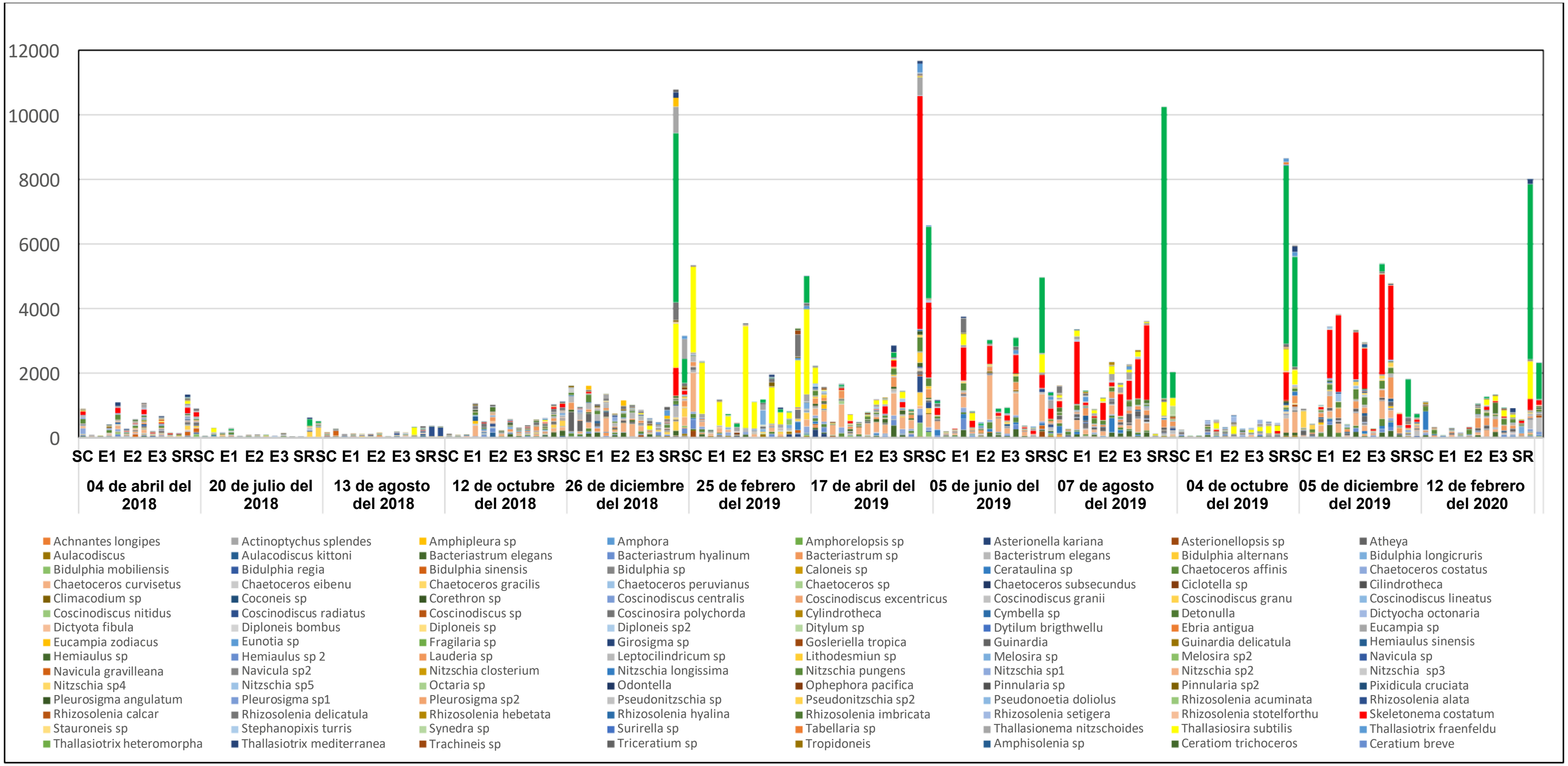
As can be seen in Figure 2, the greatest abundance of microalgae occurs precisely in the vicinity of Puerto Bolívar Project port complex, which is attributed to the higher temperature (Wohlers et al, 2009), the lower water movement and the shallower depth; however, the increases in abundance, which sometimes border the Harmful Algal Bloom (HABs) event levels, represent a decrease in diversity in periods of greater abundance.

Figure 1 Microalgae Abundance for the 2018 – 2020 Period



Prepared by: Ecosambito, 2020

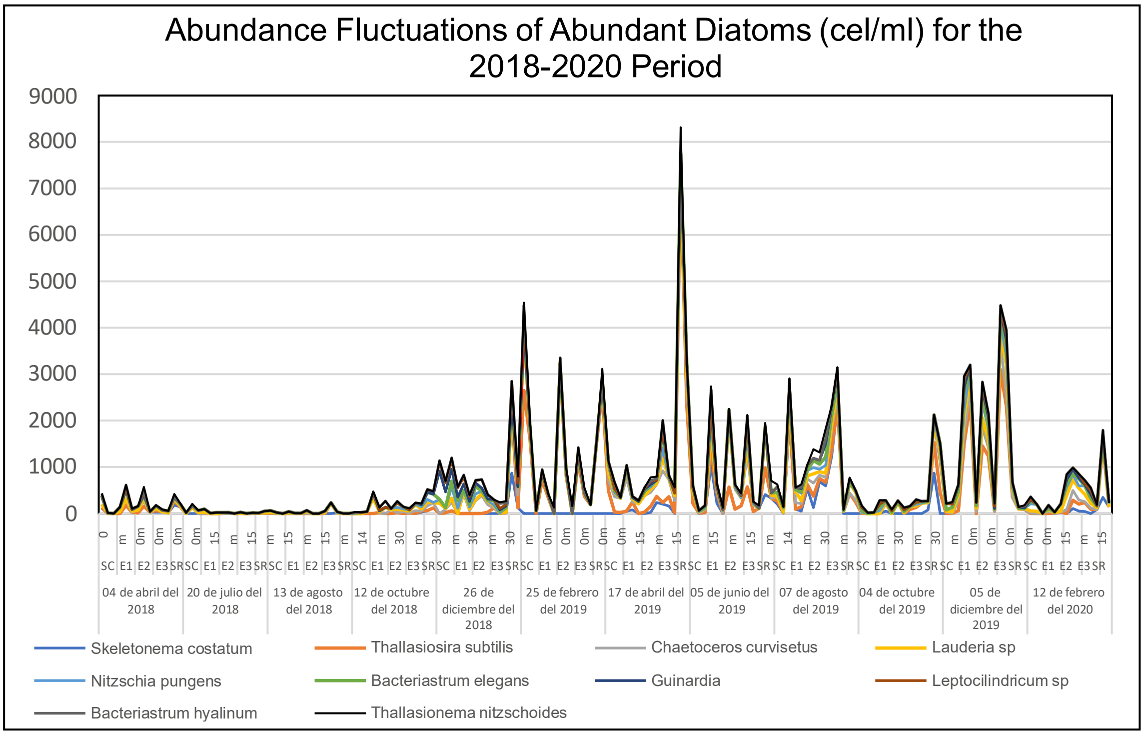
Figure 2 Microalgae Abundance and Distribution 2018-2020



Prepared by: Ecosambito, 2020

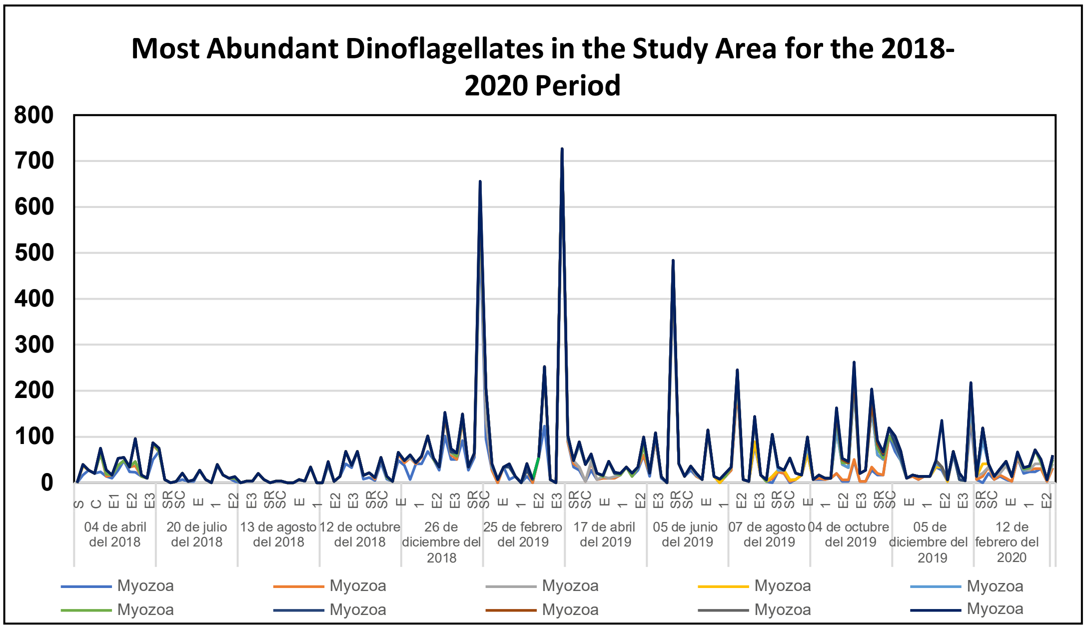
The 10 most abundant species accounted for 52% of the estimated total microalgae present in the study area. Figures 3 to 7 show the fluctuation of abundant species during the 2018-2020 period. As regards diatoms, the highest proliferation of algae was observed in the Santa Rosa estuary by April 2019; in general, there was a low abundance of diatoms in 2019 as compared to 2019.

Figure 3. Fluctuations of Most Abundant Diatoms



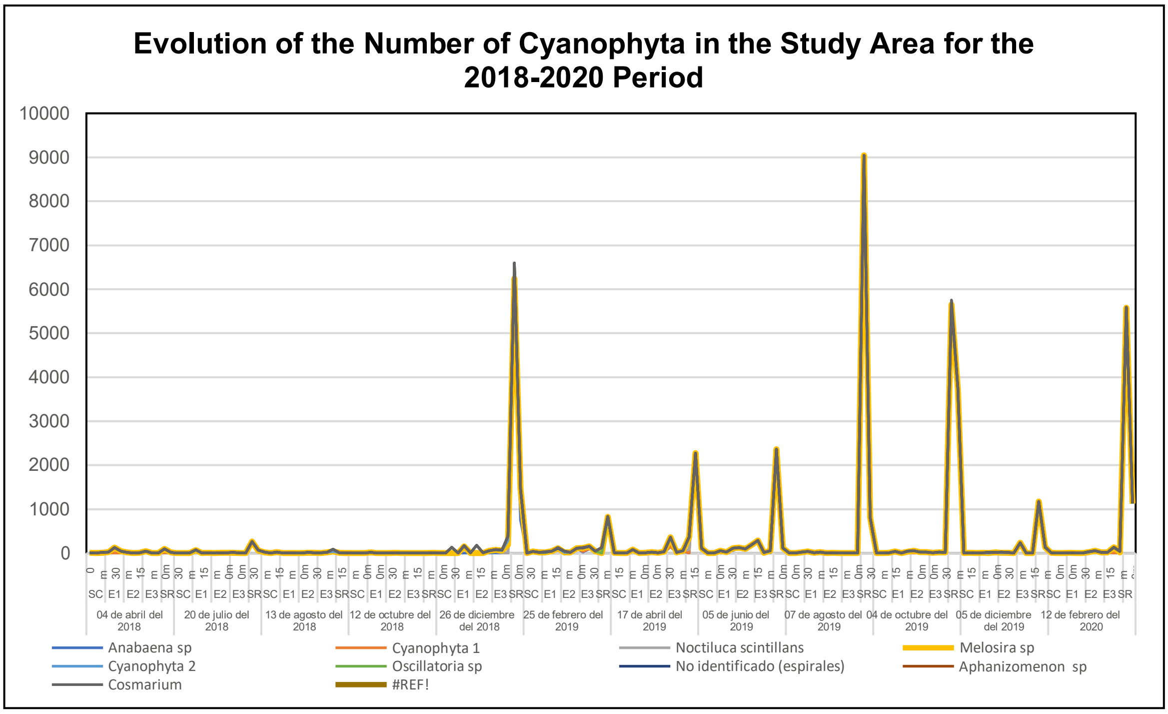
Prepared by: Ecosambito, 2020

Figure 4. Fluctuations of Dinoflagellates in the Study Area



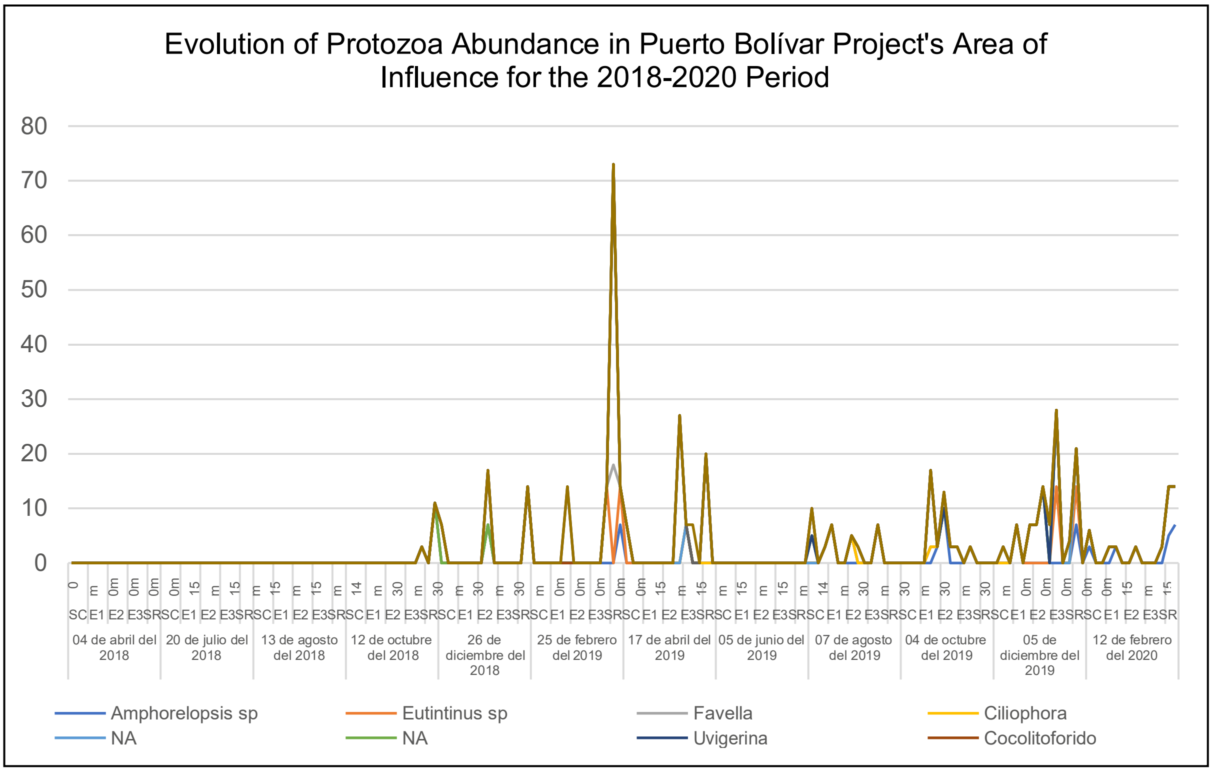
Prepared by: Ecosambito, 2020

Figure 5 Evolution of Cyanophyta Abundance



Prepared by: Ecosambito, 2020

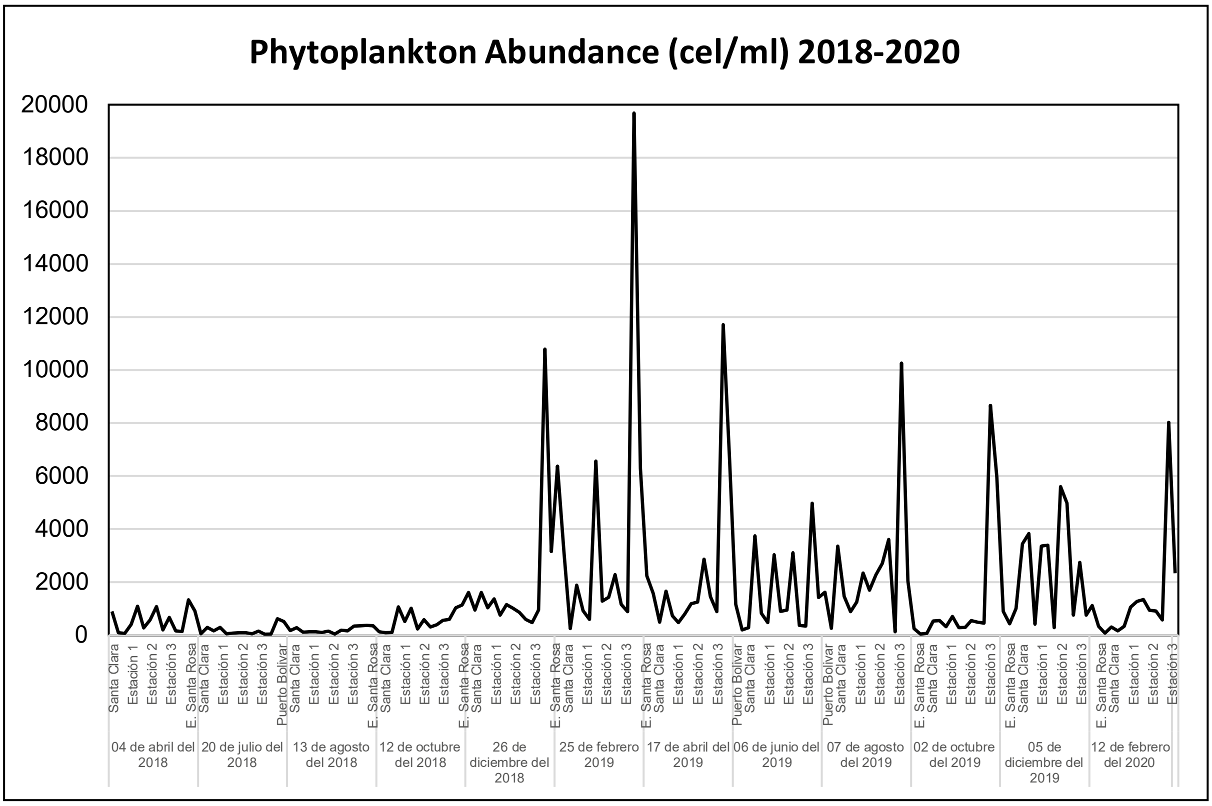
Figure 6. Evolution of Protozoa Abundance in Puerto Bolívar Project's Area of Influence



Prepared by: Ecosambito, 2020

eanic and estuarine, while cyanobacteria are abundant mainly in the Santa Rosa estuary and protozoa increased in abundance from 2019, a trend observed in all groups analyzed, with considerable interannual variations in primary productivity reflected in the total abundance of phytoplankters (Figure 7).

Figure 7. Evolution of Phytoplankton Abundance in Puerto Bolívar Project's Area of Influence

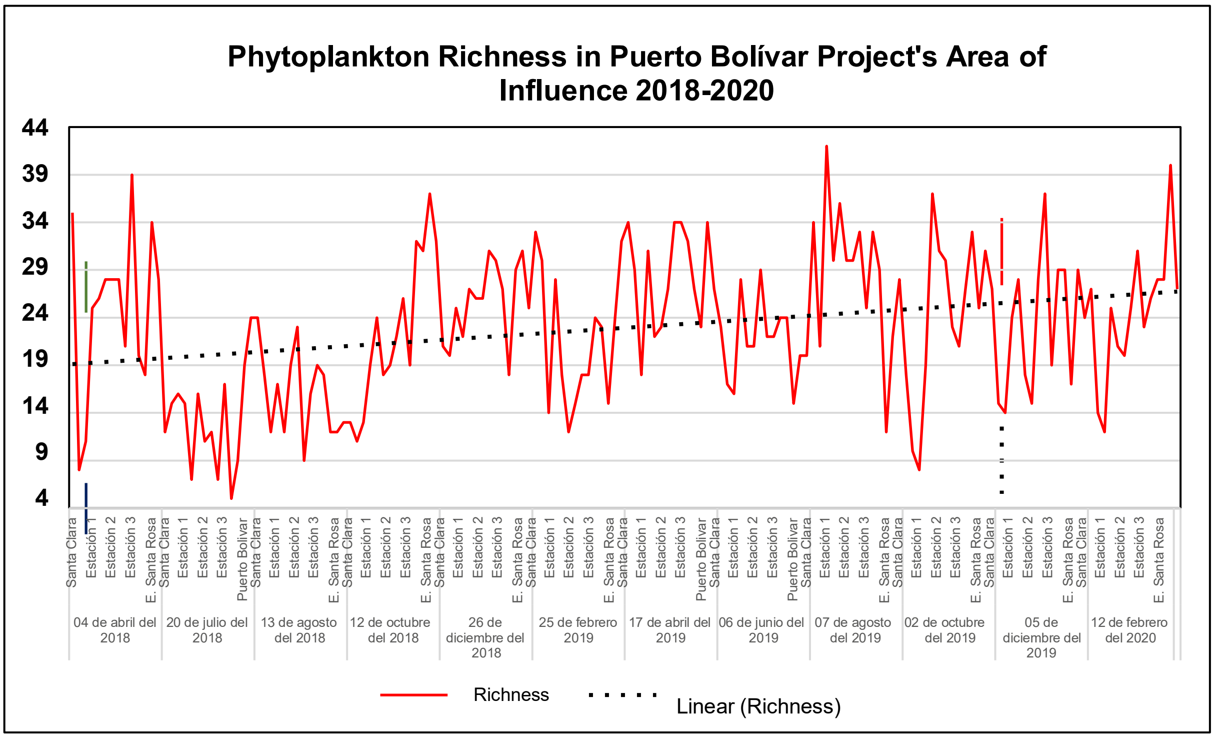


Prepared by: Ecosambito, 2020

Consistent with Figures 3 to 6, phytoplankton abundance has significantly increased since the end of 2018, recording peak values above 10,000 cel/ml in Santa Rosa estuary. The oceanic phytoplankton community can be considered abundant when it exceeds 2,000 cel/ml, which occurred in April, June, August and December 2019. Mean phytoplankton abundance in the area is considered high, with a mean of 1,549 ± 2,482 cel/ml.

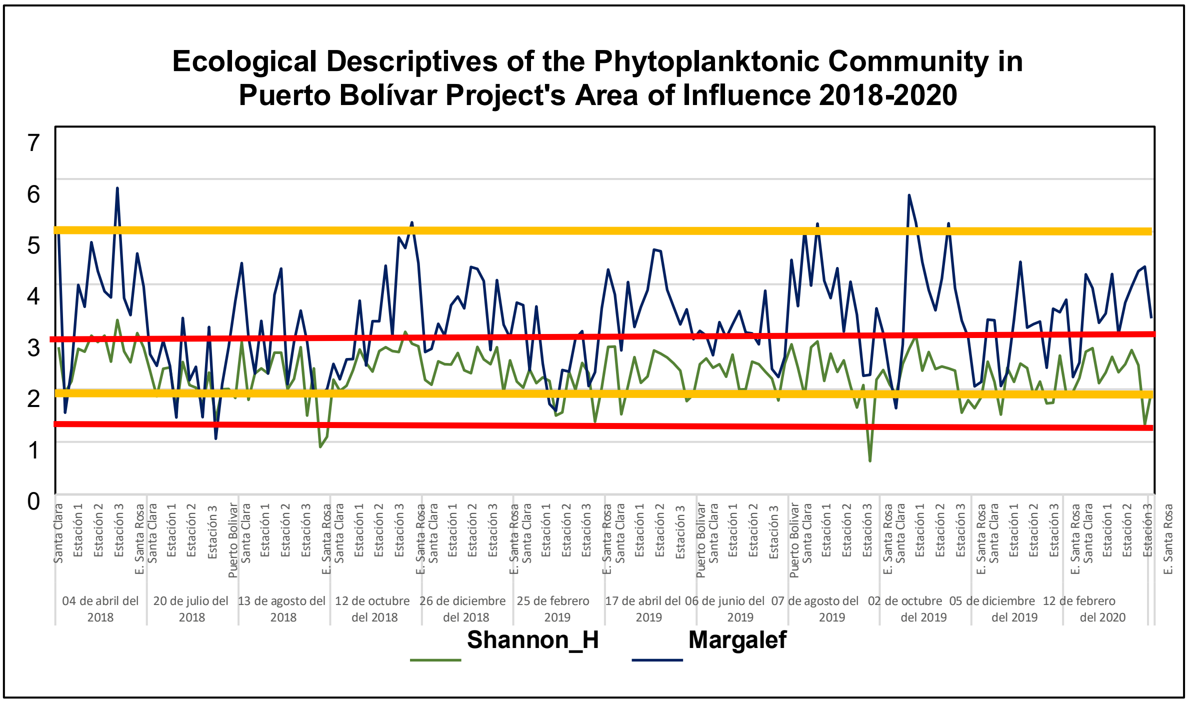
Figure 8 depicts the evolution of the phytoplankton species richness registered using 1-liter samples collected at surface (15 and 30 m). Even though the linear trend shows an increase in species, it cannot be stated that this trend is real, but it could be attributed to the greater knowledge acquired by the evaluation team, which is identifying more and more species with increased expertise. The mean phytoplankton richness per sample analyzed, integrating all depth strata and sampling sites and dates, was 22.9 ± 7.71 genera / species.

Figure 8. Evolution of Phytoplankton Species Richness



Prepared by: Ecosambito, 2020

Figure 9. Phytoplankton Diversity Descriptors

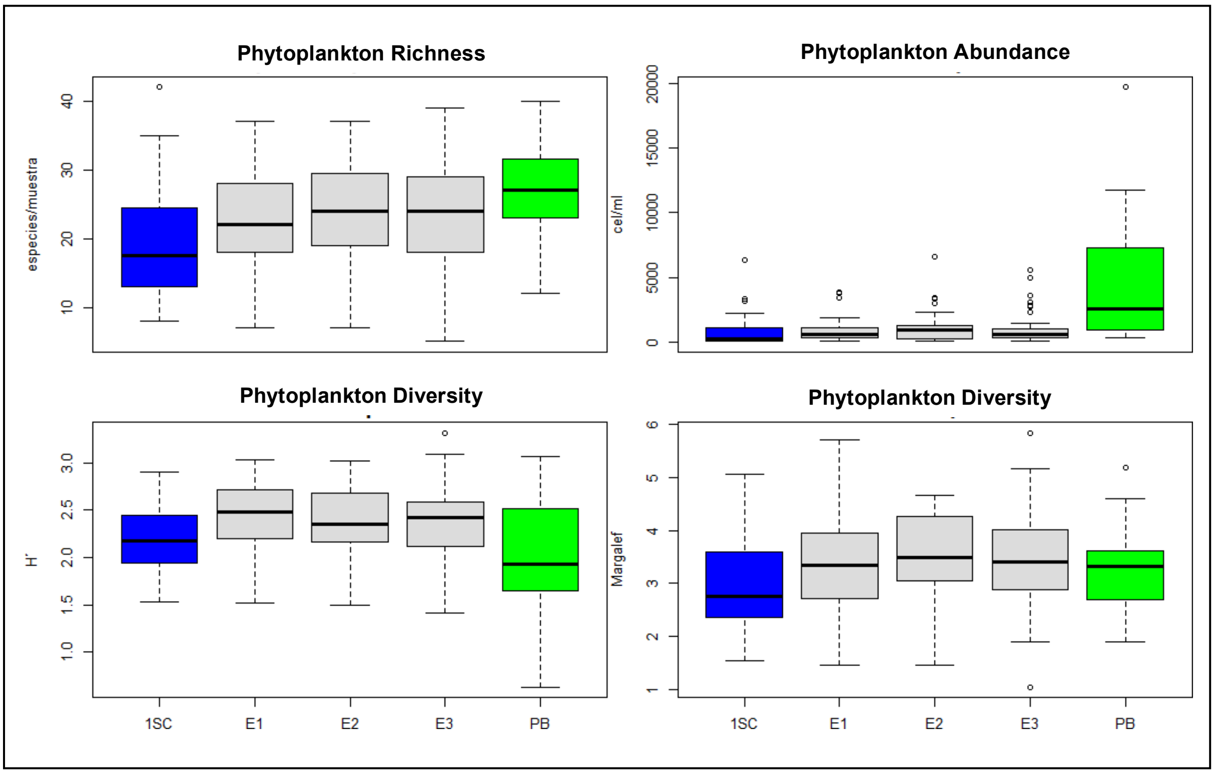


Prepared by: Ecosambito, 2020

Figure 9 shows the plankton diversity levels in Puerto Bolívar Project's area of influence. In general terms, the phytoplanktonic community of the area of influence is interpreted as a sector of intermediate diversity, which is considered to be an area with slight disturbances. The reference ranges of intermediate diversity fluctuate between 1.5 and 3 bits in Shannon H´ index. An index of more than 3 bits is interpreted as a high-diversity sector, typical of an environment with few disturbances or of good environmental quality. The Margalef index, which values species richness more than Shannon's combination of richness and abundance, establishes intermediate diversity values for the area, since it is in a range of 2 to 5. The mean diversity values in Shannon index were 2.299 ± 0.439 bits, which more closely approximates to a high-diversity sector, and they were 3.307 ± 0.90 in the Margalef index, which is considered to be intermediate diversity.

In order to better understand how the ecological variables of this community behave, Figure 10 shows the species richness, phytoplankton abundance and diversity indicators, grouping the data according to the sampling sites. The most oceanic or most offshore station is highlighted in blue (Santa Clara Island); the light colors refer to samples obtained in the deposit basin for dredged material and the green color refers to samples obtained less than 100 m away from Dock 1 in Santa Rosa estuary.

Figure 10. Sectoral Comparison of Ecological Descriptors of the Phytoplanktonic Community.

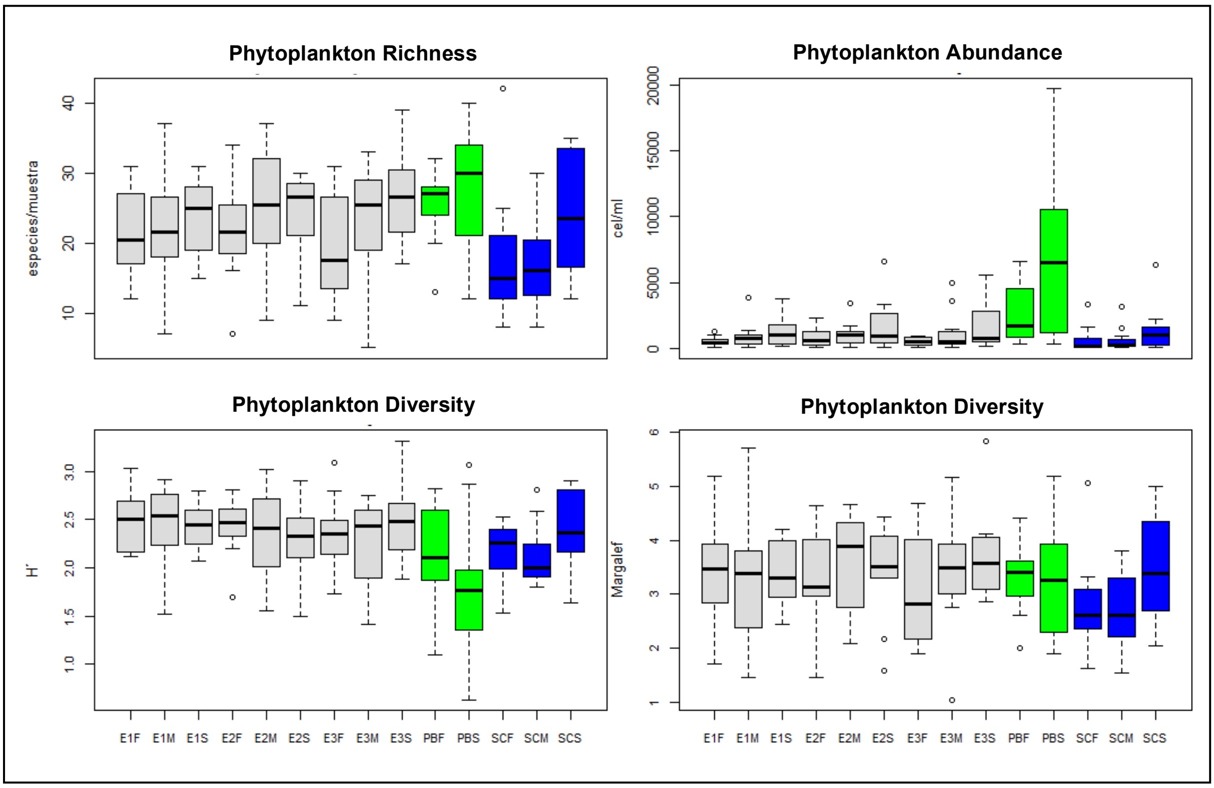


Prepared by: Ecosambito, 2020

In Figure 10, we can see a trend for increase in species as the distance from the coastal edge decreases and an evident greater abundance in inland waters of Santa Rosa estuary. The highest diversity values are found in mixing waters, that is, in the samples collected from the deposit basin for dredged material.

With a clear understanding of the existence of differences between sampling sites, the graph contained in Figure 11 was obtained by introducing the variable depth at which the sample was acquired.

Figure 11. Ecological Descriptors of Phytoplankton grouped by Site and Depth



Prepared by: Ecosambito, 2020

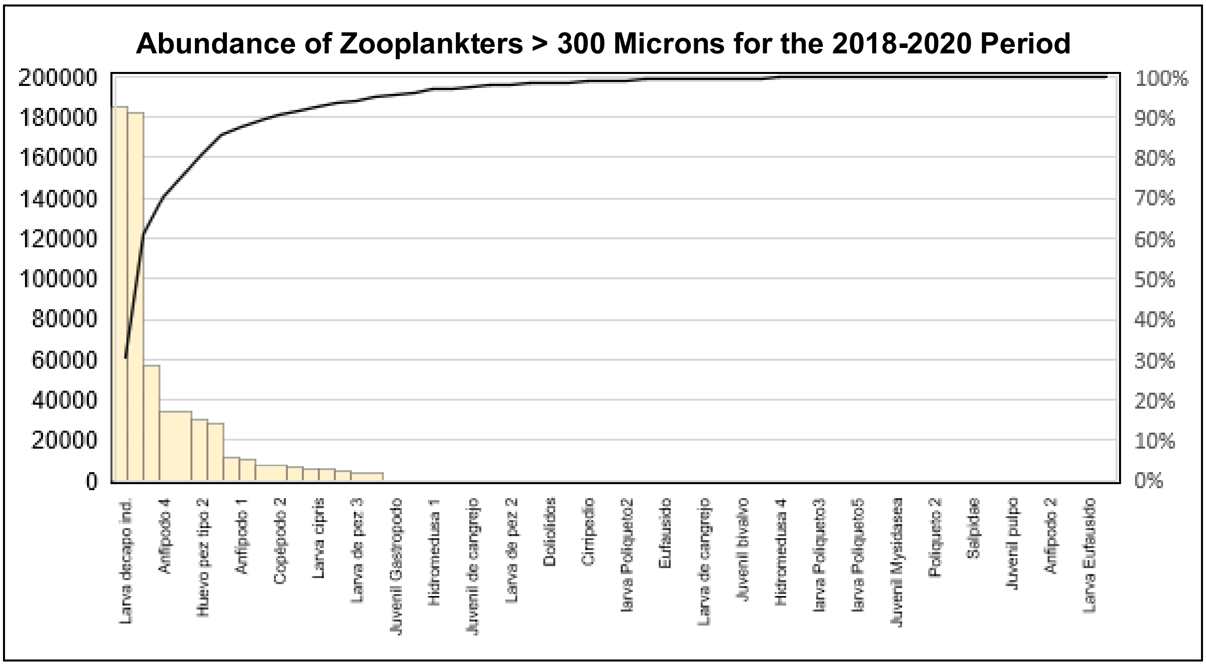
When grouping the ecological descriptors by sites and depths, we can observe a considerable difference in the abundance of algae present in the vicinity of Dock 1 of Puerto Bolivar. Here there are almost 4 times more abundance of phytoplankton species than on the surface of the other monitoring sites, as evidenced by the mean values described below.

```
tapply(Abundancia,`Profundidad (m)`,mean)
      E1F       E1M       E1S       E2F       E2M       E2S       E3F
 513.2500  924.5500 1336.5833  790.8167 1073.7833 1676.5417  513.6250
      E3M       E3S       PBF       PBS       SCF       SCM       SCS
1217.2000 1673.9667 2623.9692 6686.4567  635.2750  647.6183 1380.4500
> tapply(Abundancia,`Profundidad (m)`,sd)
      E1F       E1M       E1S       E2F       E2M       E2S       E3F
 349.1718  999.3217 1203.9470  683.4216  894.9811 1896.2788  317.5826
      E3M       E3S       PBF       PBS       SCF       SCM       SCS
1522.6662 1666.4045 2347.0068 5914.3812  978.0253  909.8523 1716.1857
```

3.2 Zooplankton > 300 microns

The samplings made in the 2018-2020 period revealed a richness of no less than 54 different zooplankters > 300 microns: 22 crustaceans, 3 chaetognaths, 7 polychaetes, 1 larvacean, 4 urochordates, 5 cnidarians, 3 mollusks, 1 echinoderm and 8 fish eggs and larvae. The database of zooplanktonic samples of the fraction larger than 300 microns is not included in the IUCN Redlist. The abundance of zooplankters of this fraction is shown in Figure 12 and Figure 13 shows their distribution and abundance, showing the occurrence of pulses of zooplanktonic increases linked to massive reproductive events linked to samples taken on dates close to the seasonal changes.

Figure 12. Cumulative Abundance of Zooplankters after two Years of Monitoring using 300-Micron 3-Minute Trawls



Prepared by: Ecosambito, 2020

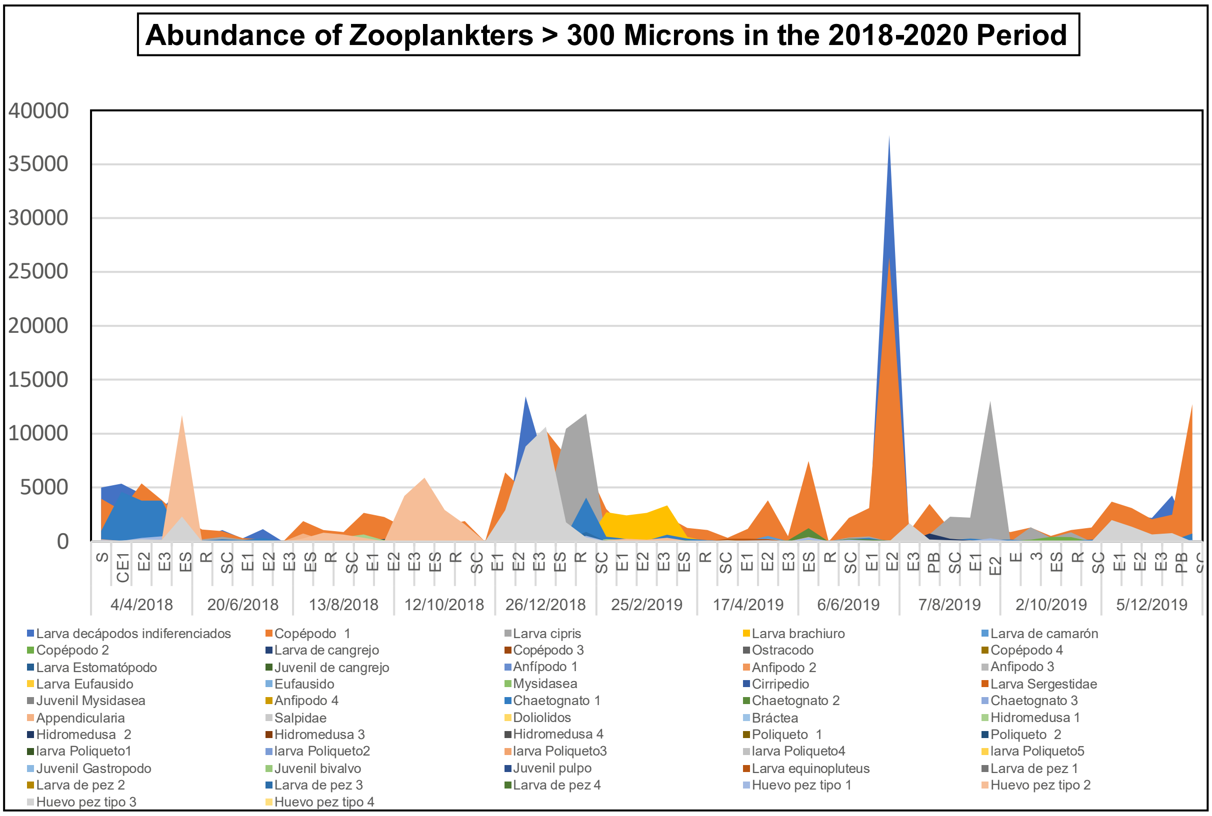
As will be discussed below, zooplankton diversity is not high due to its relationship with reproductive pulses corresponding to those moments at which the presence of specific larvae increases excessively. Of the 57 zooplankters identified, the 10 most abundant ones account for 91% of the estimated total individuals, which are shown in Table 5.

Table 5. Most Abundant Zooplankters > 300 Microns in the Project's Area of Influence

	Type of Zooplankter	Relative Abundance %
1	Larva decapod ind.	30%
2	Copepod 1	30%
3	Amphipod 4	9%
4	Fish egg type 3	6%
5	Fish egg type 2	5%
6	Chaetognaths 1	5%
7	Amphipod 1	2%
8	Egg fish type 1	2%
9	Copepod 2	1%
10	Chaetognaths 2	1%

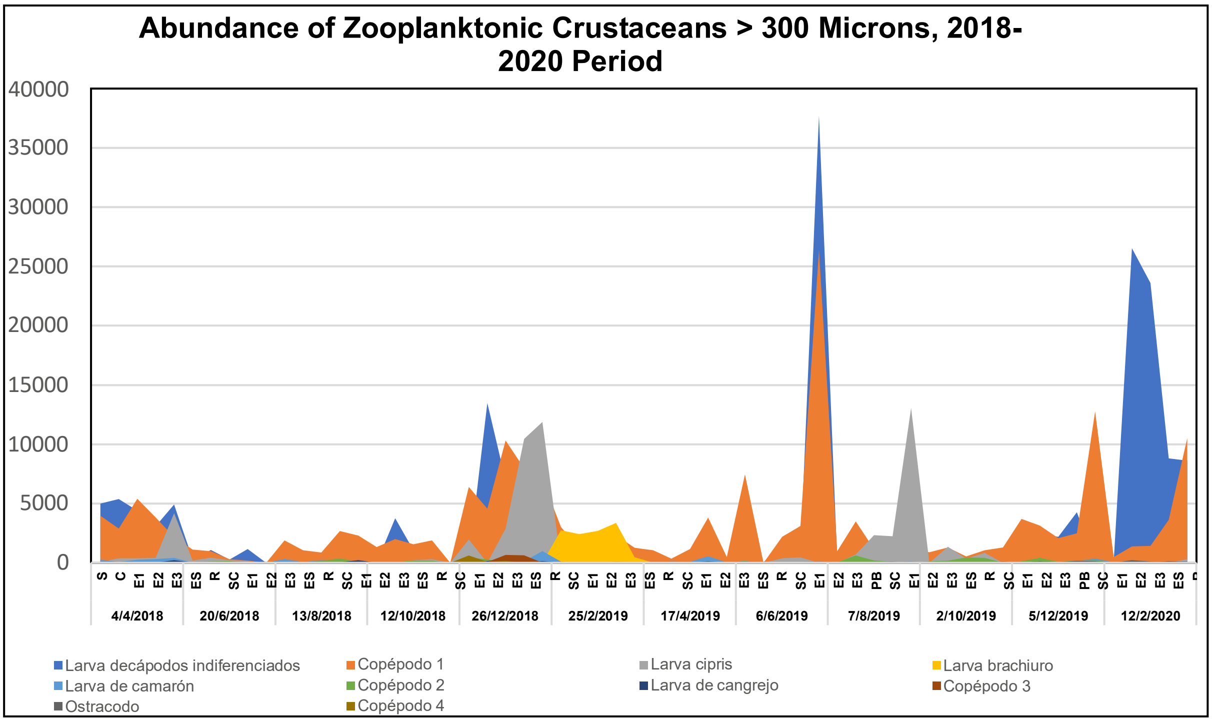
Prepared by: Ecosambito, 2020

Figure 13. Zooplankton Abundance "Pulses" associated with Seasonal Changes



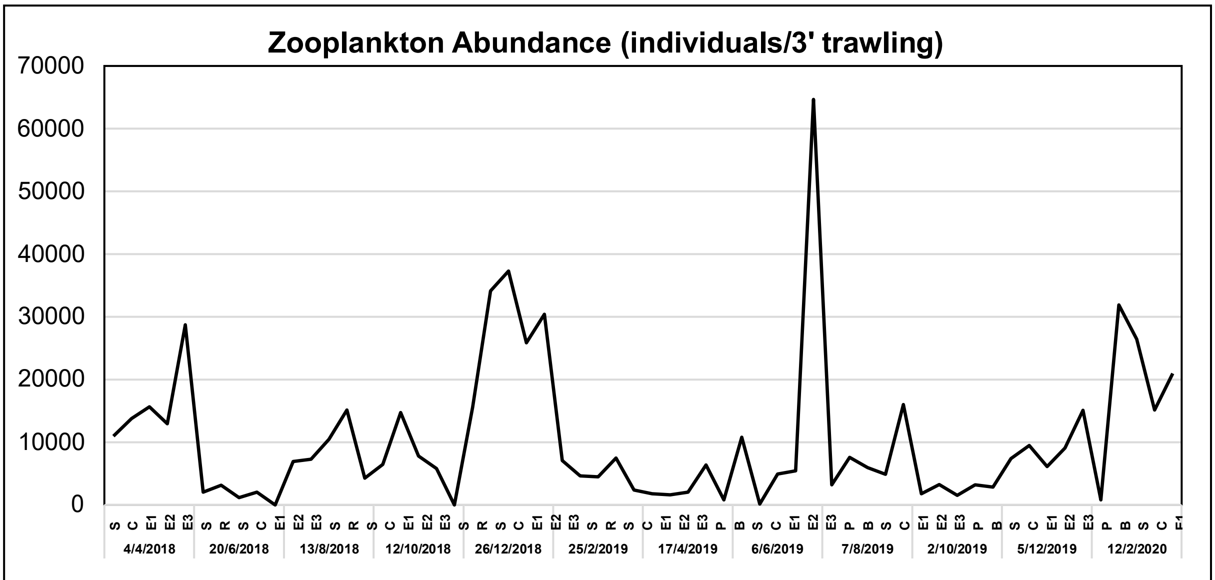
Prepared by: Ecosambito, 2020

Figure 14. Evolution of Abundance of Zooplanktonic Crustaceans > 300 Microns



Prepared by: Ecosambito, 2020

Figure 15. Abundance of Zooplankters > 300 Microns



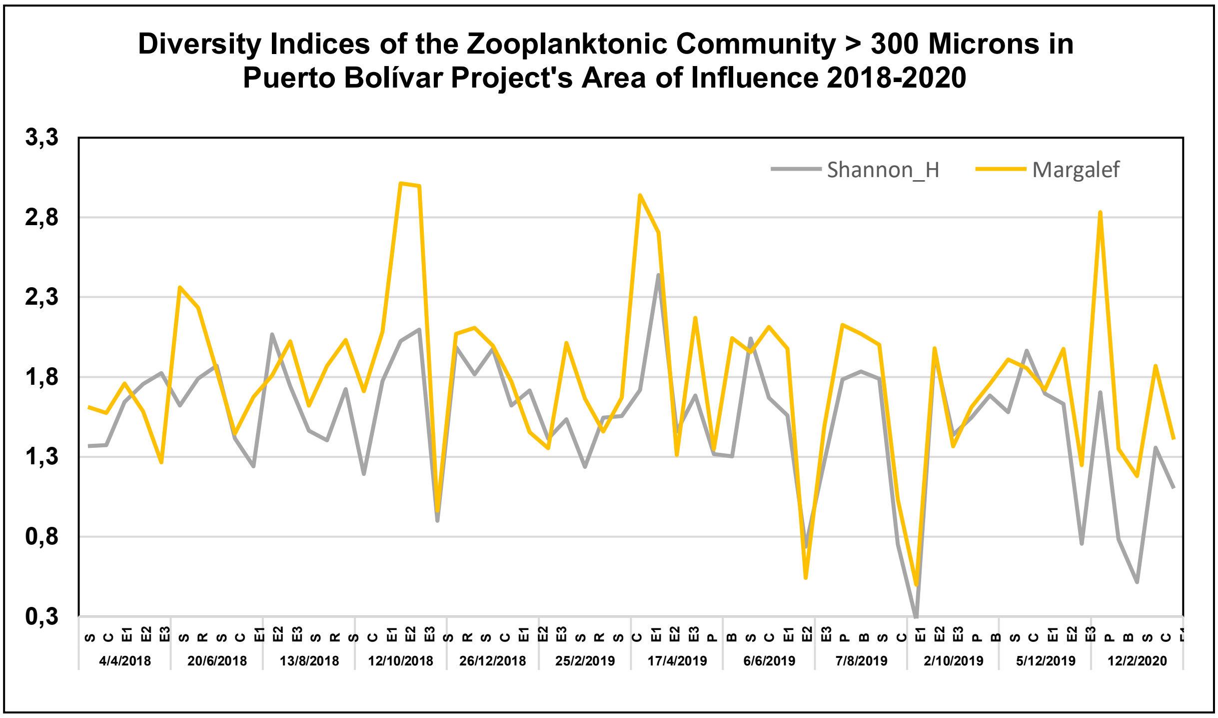
Prepared by: Ecosambito, 2020

In Figure 11 and Figure 12, it can be seen that most zooplankters > 300 microns are crustaceans, the average total abundance of zooplankters > 300 microns was 10,506 ± 11,651 individuals collected using a 300-micron net with a 38-cm diameter mouth that was trawled for 3 minutes.

The richness of zooplankters was variable. However, considering all trawls without discriminating among sectors and dates, there was an average of 15.53 ± 4.62 different types of zooplankters per trawl. The zooplankton diversity of the fraction > 300 microns was 1.534 ± 0.409 bits in the Shannon H' index and 1.790 ± 0.506 in the Margalef index, with this community being interpreted as a low-diversity one, which is not considered as poor condition but rather as a response to massive bloom-like reproductions or larval pulses where the abundance of a few species that dominate the water column increases significantly.

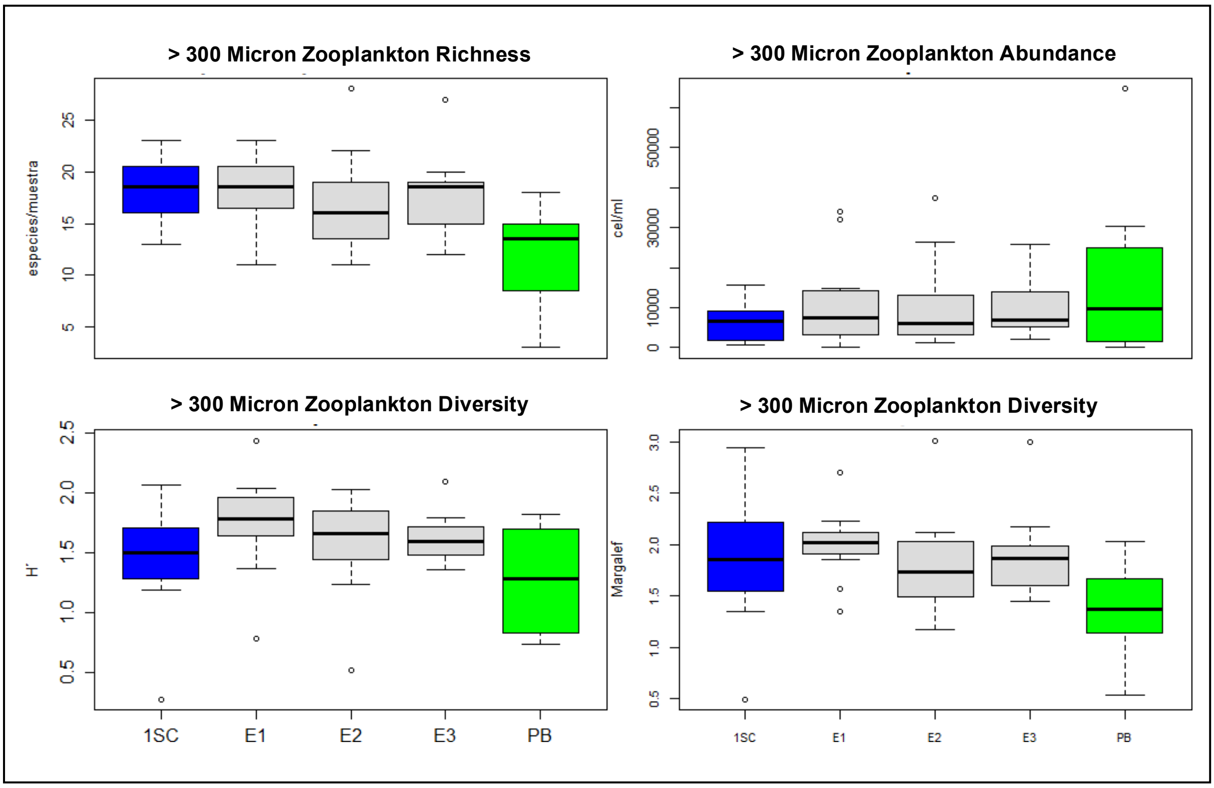
With regard to the sectoral variables of the zooplanktonic community > 300 microns, their general descriptors are presented in Figure 16. Such figure shows a greater zooplankton abundance in terms of the number of animals collected in a 3-minute trawl in the sector near Puerto Bolívar facilities, which is in turn the least diverse site, a situation that indicates the dynamics of larval pulses near the coastal edge, which will later integrate into the coastal benthic communities as they develop.

Figure 16. Diversity Variations in the Zooplankton Fraction > 300 Microns



Prepared by: Ecosambito, 2020

Figure 17. Sectoral Comparison of Ecological Descriptors of the Zooplankton Fraction > 300 Microns without considering the Time Variable



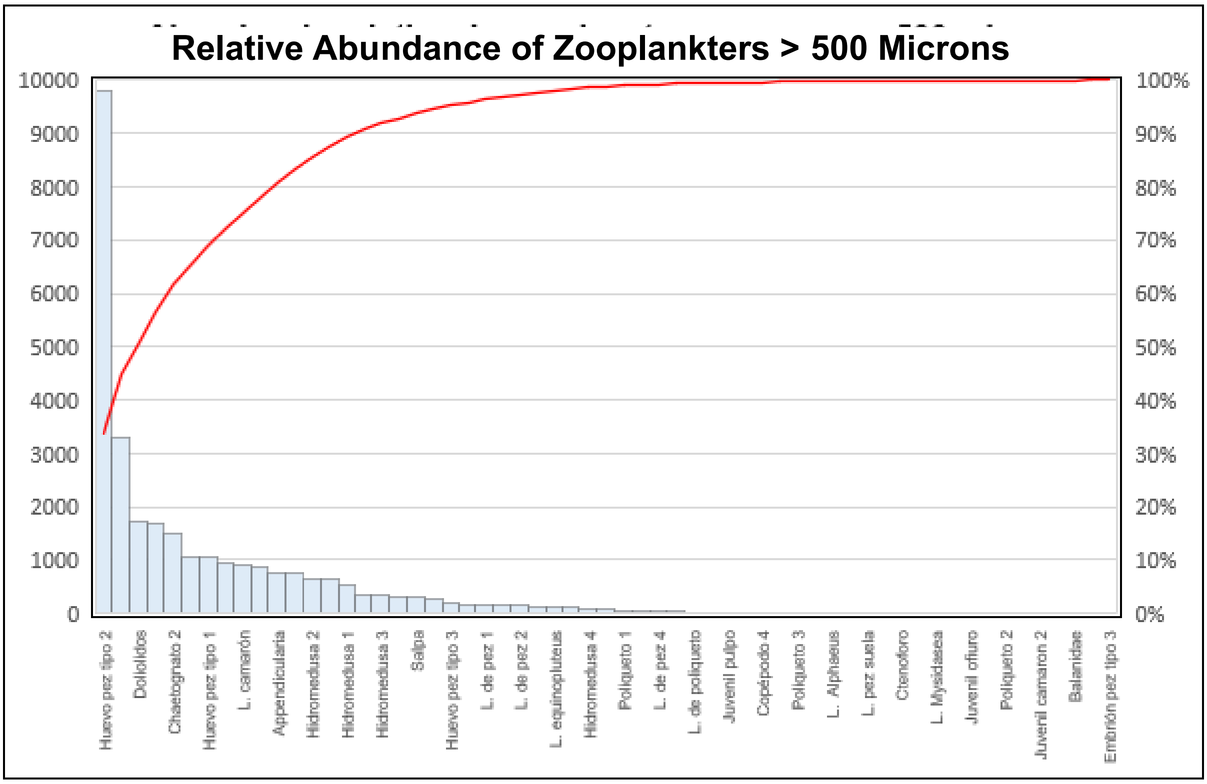
Prepared by: Ecosambito, 2020

3.3 Zooplankton > 500 Microns

In the 3-minute trawl collections with 500 micron nets, 59 different zooplankters were identified: 21 crustaceans, 3 chaetognaths, 6 polychaetes, 1 larvae, 3 urochordates, 1 ctenophore, 6 cnidarians, 3 mollusks, 3 echinoderms and 12 fish eggs and larvae, these, as with the fraction greater than 300 microns, do not make the Redlist because they correspond to initial stages of species whose adults possibly do.

Figure 17 shows the abundance of zooplankters considering all the estimates from total collections of each trawl.

Figure 18. Most Abundant Zooplankters in the Project's Area of Influence in the 2018-2020 Period.



Prepared by: Ecosambito, 2020

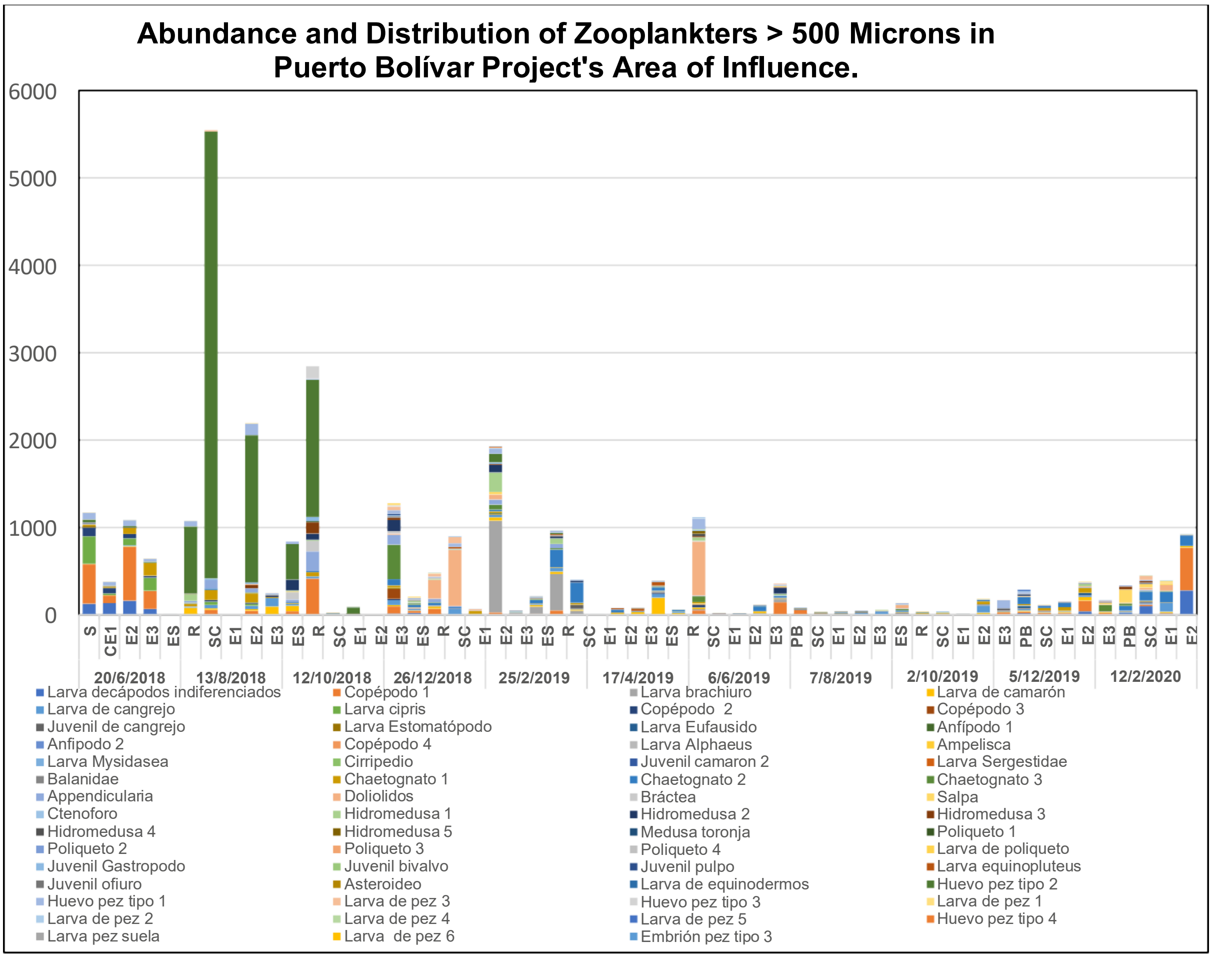
Figure 18 shows that zooplankton organisms > 500 microns are less diverse due to the disproportionate abundance of the most abundant species: the type 2 fish eggs that accounted for more than 30% of all the organisms computed and the 10 most abundant zooplankters that exceeded 78% of the estimated organisms as shown in Table 6.

Table 6. Most Abundant Zooplankters in the Fraction > 500 Microns

Ranking	Type	Relative Abundance %
1	Type 2 fish egg	33.62%
2	Copepod 1	11.28%
3	Doliolids	5.88%
4	Brachyura larvae	5.73%
5	Chaetognaths 2	5.19%
6	Egg fish type 1	3.59%
7	Larvae of undifferentiated decapods	3.61%
8	Chaetognaths 1	3.19%
9	Shrimp larvae	3.08%
10	Crab larvae	2.95%
		78.12%

Prepared by: Ecosambito, 2020

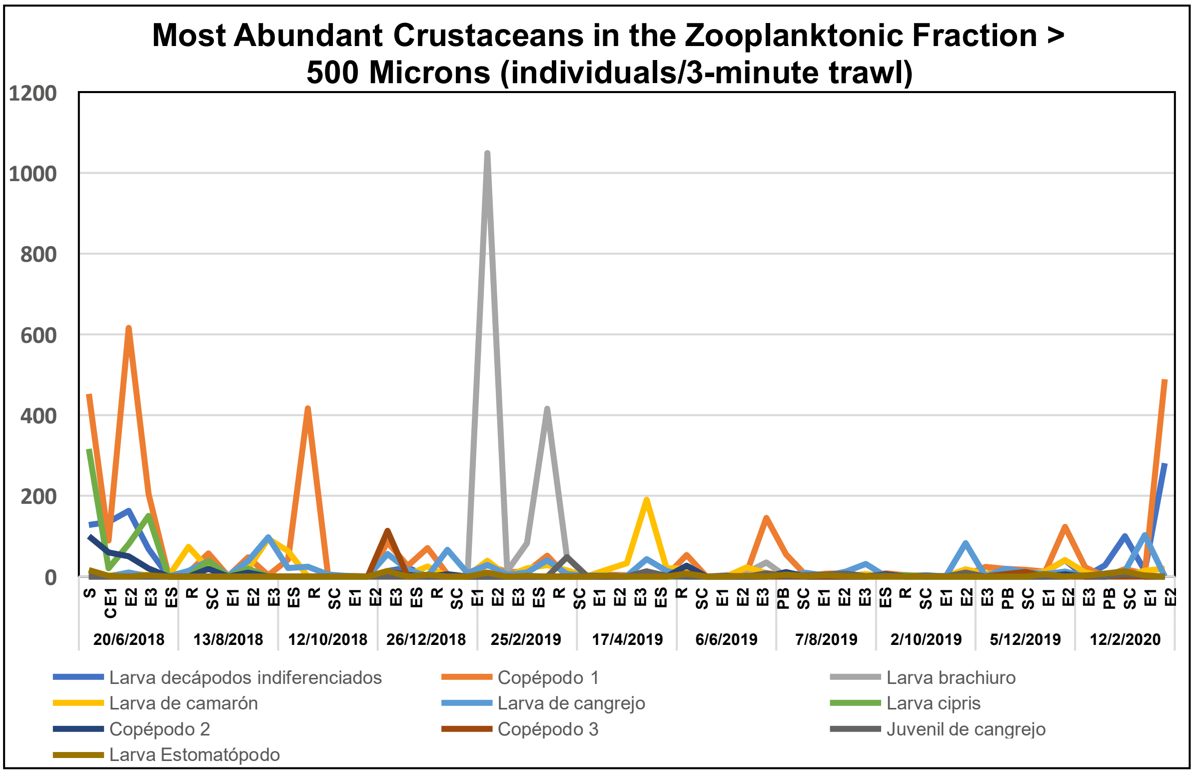
Figure 19. Abundance and Distribution of Zooplankters > 500 Microns collected during 2018-2020 Monitoring.



Prepared by: Ecosambito, 2020

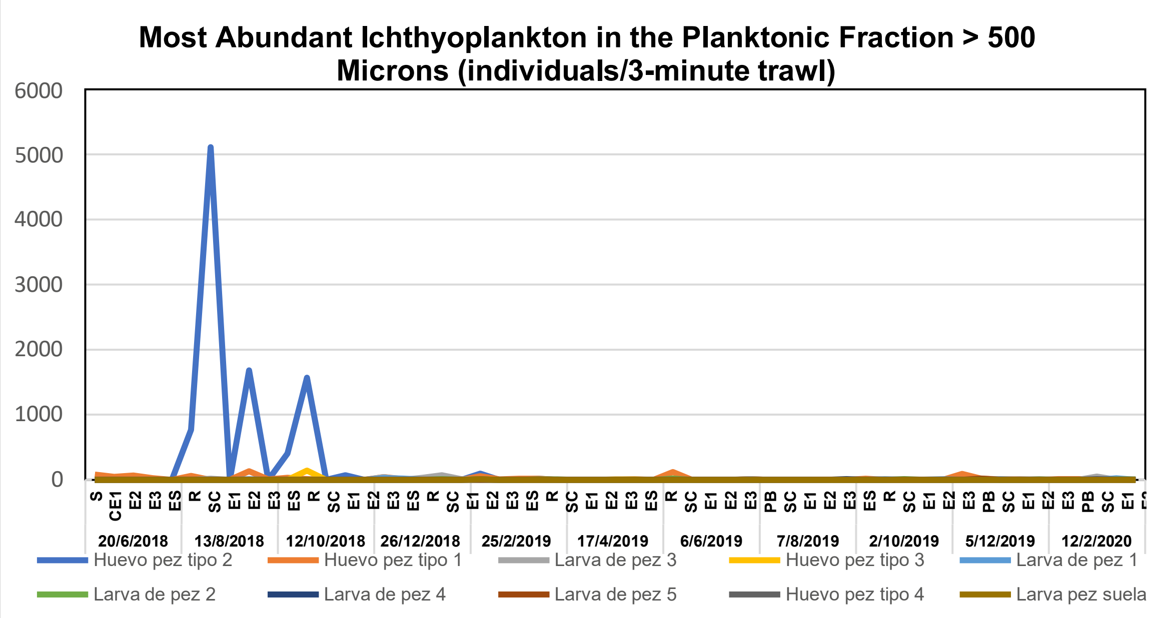
In Figure 19, it can be seen that the greatest abundance of zooplankters > 500 microns occurred in August 2018, with a significance presence of these type 2 fish eggs within the boundaries of the deposit basin for dredged material.

Figure 20. The 10 Most Abundant Crustaceans in the Zooplanktonic Fraction > 500 Microns



Prepared by: Ecosambito, 2020

Figure 21. Most Abundant Ichthyoplankters in the Zooplanktonic Fraction > 500 Microns

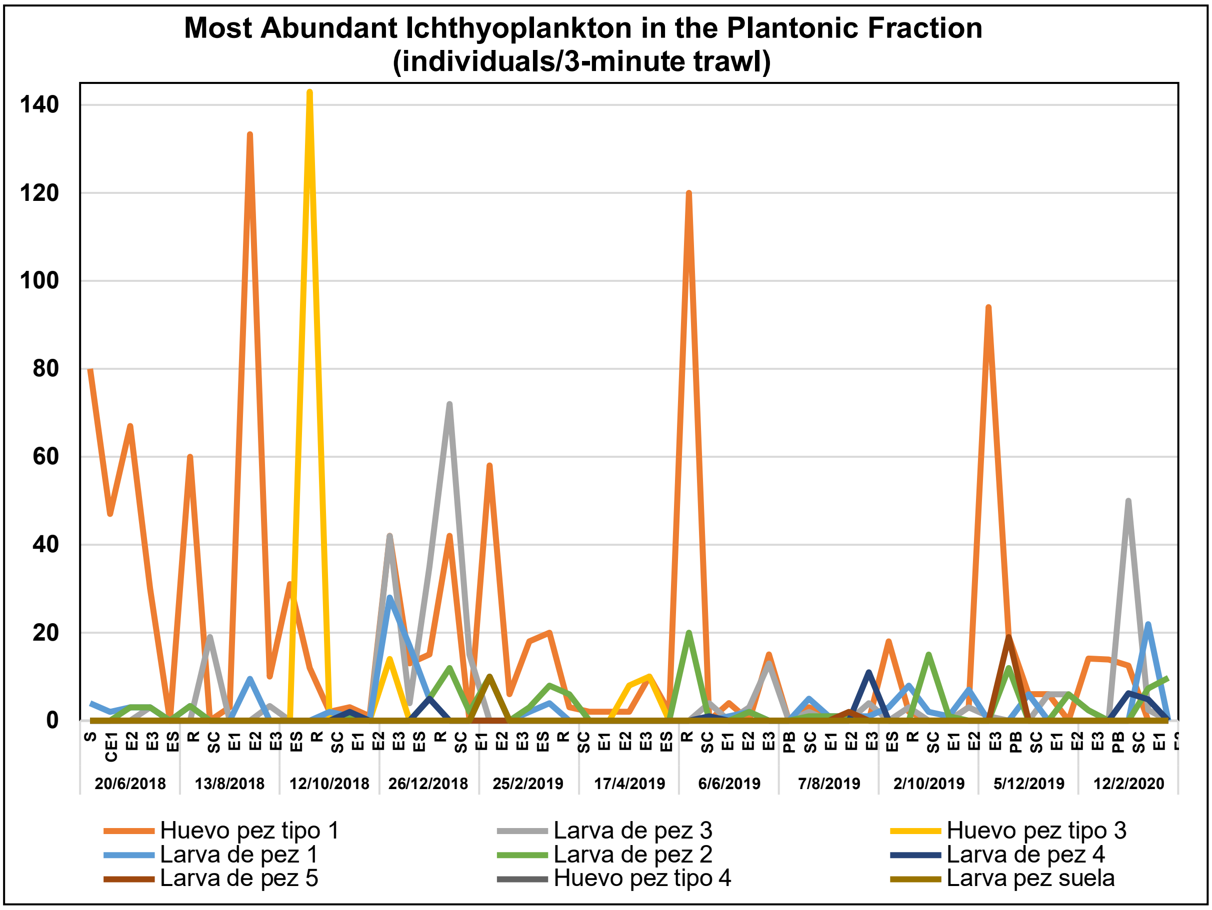


Prepared by: Ecosambito, 2020

From the "pulses" of crustacean and fish abundance in the most developed zooplanktonic community, it can be observed that the highest pulses of crustaceans occur on seasonal transition dates, while the highest pulses of fish would occur in the last four months of 2018 in the case of type 2 fish eggs. The fact that the same fish eggs type 2 were not registered on similar dates of 2019 calls our attention.

Given the disproportionate abundance of such pulse of fish eggs in 2018, these results were removed from Figure 21, which shows a continuous reproductive activity of fish throughout the period analyzed as well as the founding effect of Santa Clara Island.

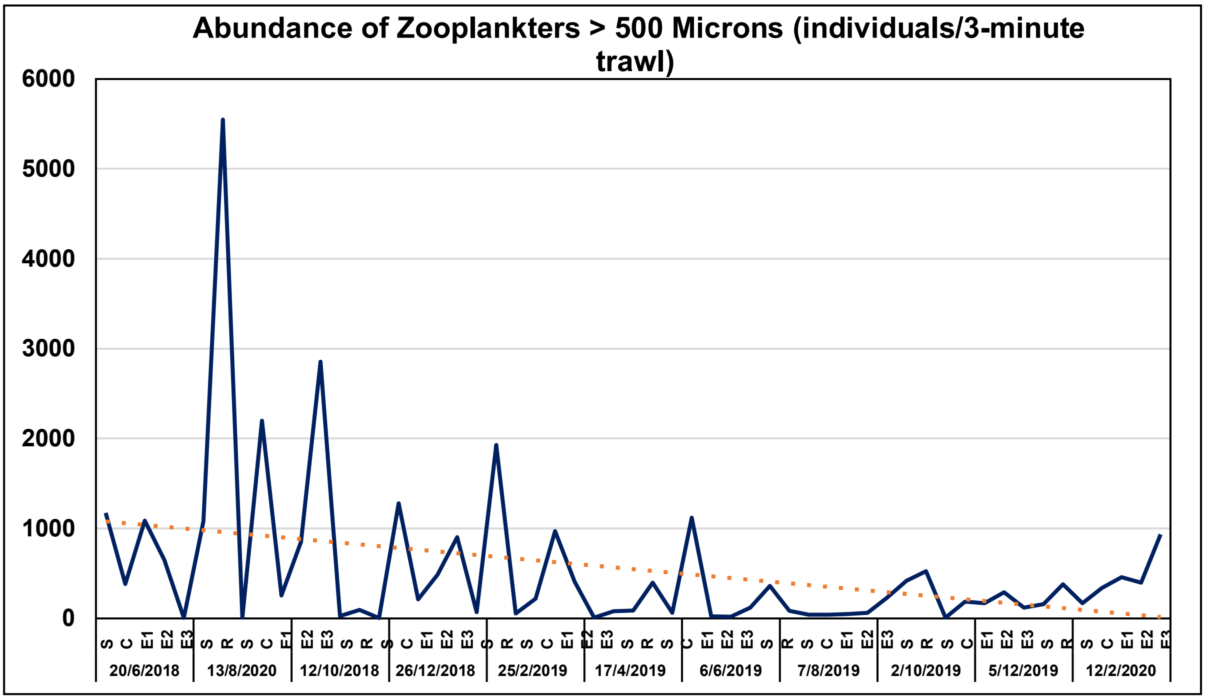
Figure 22. Ichthyioplankters Registered in this Study.



Prepared by: Ecosambito, 2020

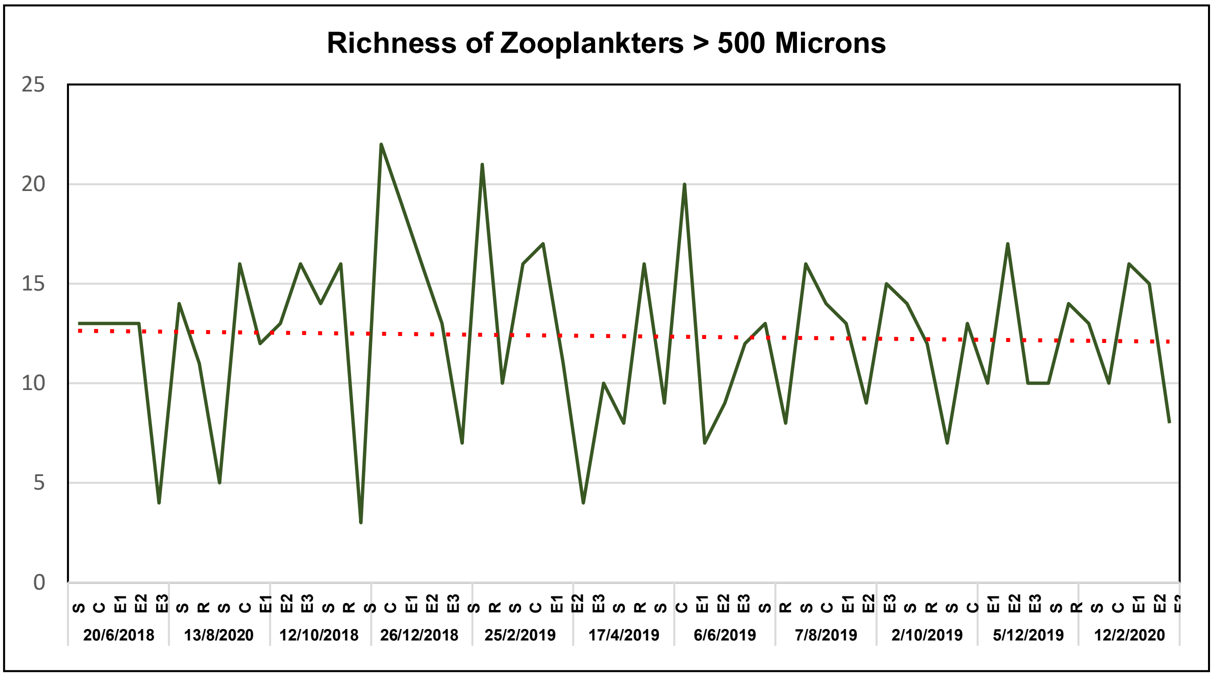
In order to better understand how this community behaves in general terms, Figures 23 to 25 depict the temporary evolution of general ecological descriptors of the zooplankter fraction > 500 microns.

Figure 23. Abundance of Zooplankters > 500 Microns



Prepared by: Ecosambito, 2020

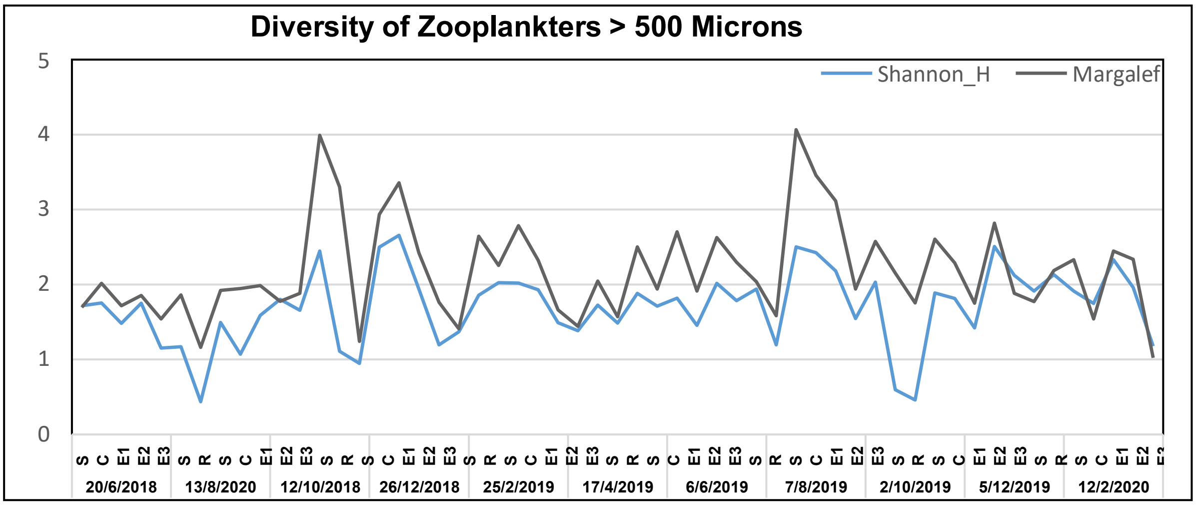
Figure 24. Temporary Evolution of Richness of Zooplankters > 500 Microns in the Project's Area of Influence.



Prepared by: Ecosambito, 2020

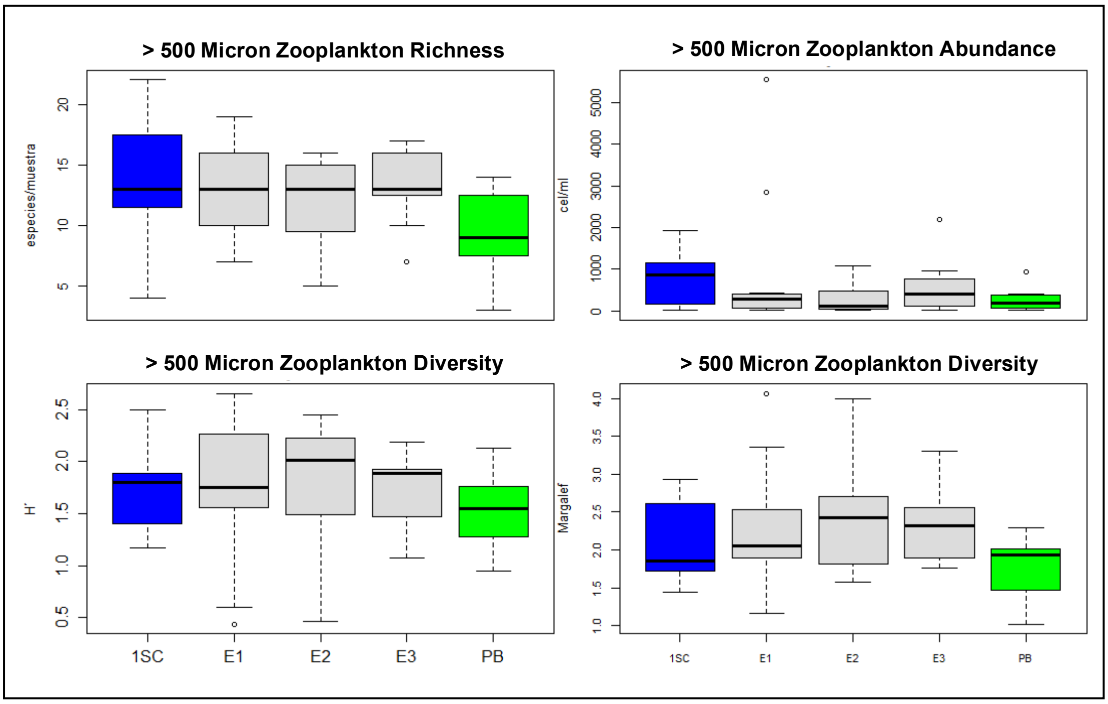
Figure 25 shows that the diversity ranges of this zooplanktonic fraction are mostly close to descriptors of low diversity that could be erroneously interpreted as a sector of poor environmental quality, but that in reality indicates the functioning of sectoral pulses that can be seen in Figure 26.

Figure 25. Evolution of Zooplankton Diversity > 500 Microns.



Prepared by: Ecosambito, 2020

Figure 26. Sectoral Comparison of Zooplankton Descriptors of the Fraction > 500 Microns



Prepared by: Ecosambito, 2020

Figure 26 shows that unlike the phytoplankton community and the fraction greater than 300 microns, there is a greater richness of beings of this zooplanktonic fraction towards the oceanic water limit and this greater richness responds to the presence of hard and mixed bottoms in the vicinity of Santa Clara Island.

3.4 Benthic Community

The monitoring samplings for the period 2018-2020 recorded a richness of 70 benthic species in the area of influence of the Project: 11 crustaceans, 30 mollusks including 1 scaphopod or sea fang, 17 bivalves and 12 gastropods; in addition to 3 echinoderms, 1 cnidarian, 1 nemertean, 21 polychaetes, 1 sipunculid, 1 priapulid and 1 flatworm. Of the 70 benthic creatures collected, two species, the snail Polinices grayi is considered vulnerable and the crustacean Alphaeus sp or pistol shrimp is considered endangered according to the IUCN Redlist.

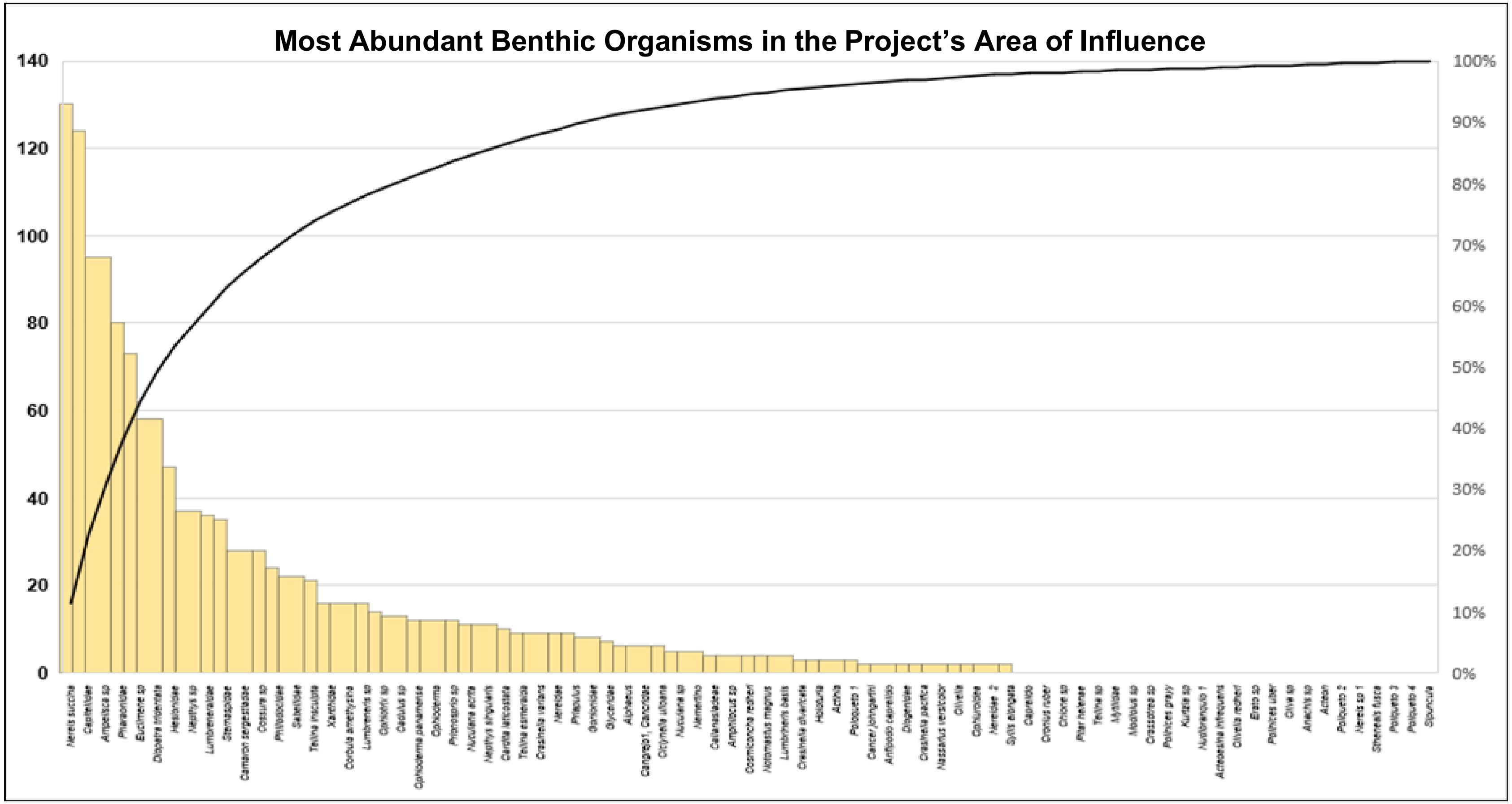
Figure 26 shows data on the total abundance of creatures collected with a Van Been dredge without discriminating between sectors and dates, as well as their temporal and spatial distribution, which appears in Figure 27, polychaetes were the most abundant species and showed considerable differences in abundance with respect to the dredging maneuvers in the sector of the deposit basin, effectively fulfilling a role as a bioindicator community of marine environmental quality given their relatively fixed residence, their long life spans and their ease of sampling, although several species were not easy to identify due to the lack of national dichotomous keys, resorting to reference texts from Mexico.

Table 7. Most Abundant Benthic Organisms found during the Monitoring

Ranking	Genus/Species	Relative Abundance %
1	*Nereis succinea*	11.5%
2	*Capitellidae*	10.9%
3	*Ampelisca sp*	8.4%
4	*Pharaonidae*	7.1%
5	*Euclimene sp*	6.4%
6	*Diopatra tridentata*	5.1%
7	*Hesionidae*	4.1%
8	*Nepthys sp*	3.3%
9	*Lumbreneraidae*	3.2%
10	*Sternaspidae*	3.1%
11	*Camaron sergestiadae*	2.5%
12	*Cossura sp*	2.5%
13	*Phillodocidae*	2.1%
14	*Sabellidae*	1.9%
15	*Tellina insculpta*	1.9%
16	*Xanthidae*	1.4%
17	*Corbula amethysina*	1.4%
18	*Lumbreneris sp*	1.4%
19	*Ophiotrix sp*	1.2%
20	*Cadulus sp*	1.1%
	Cumulative abundance	80.51%

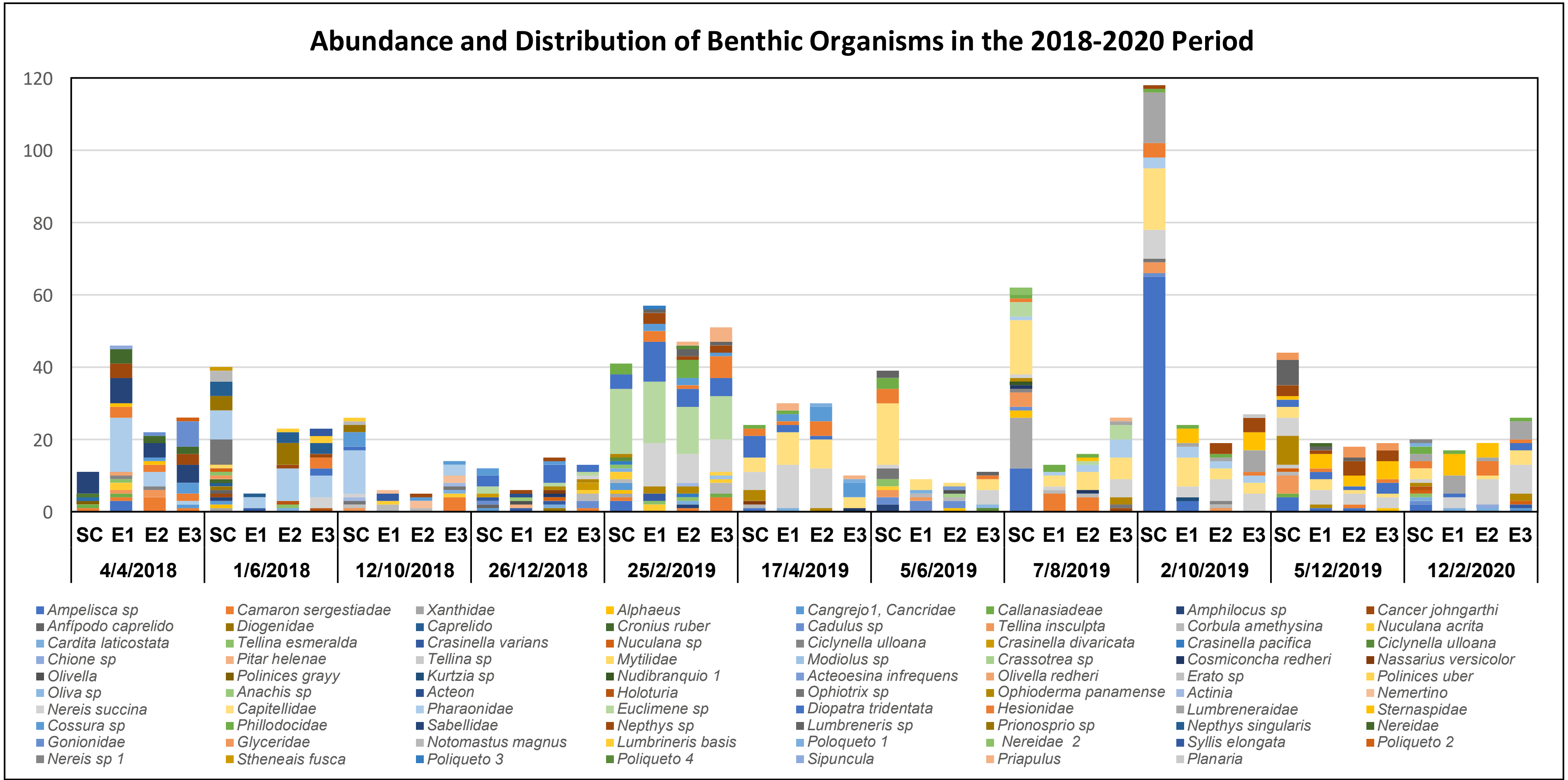
Prepared by: Ecosambito, 2020

Figure 27. Abundance of Benthic Organisms collected during the 2018-2020 Monitoring in the Project's Area of Influence



Prepared by: Ecosambito, 2020

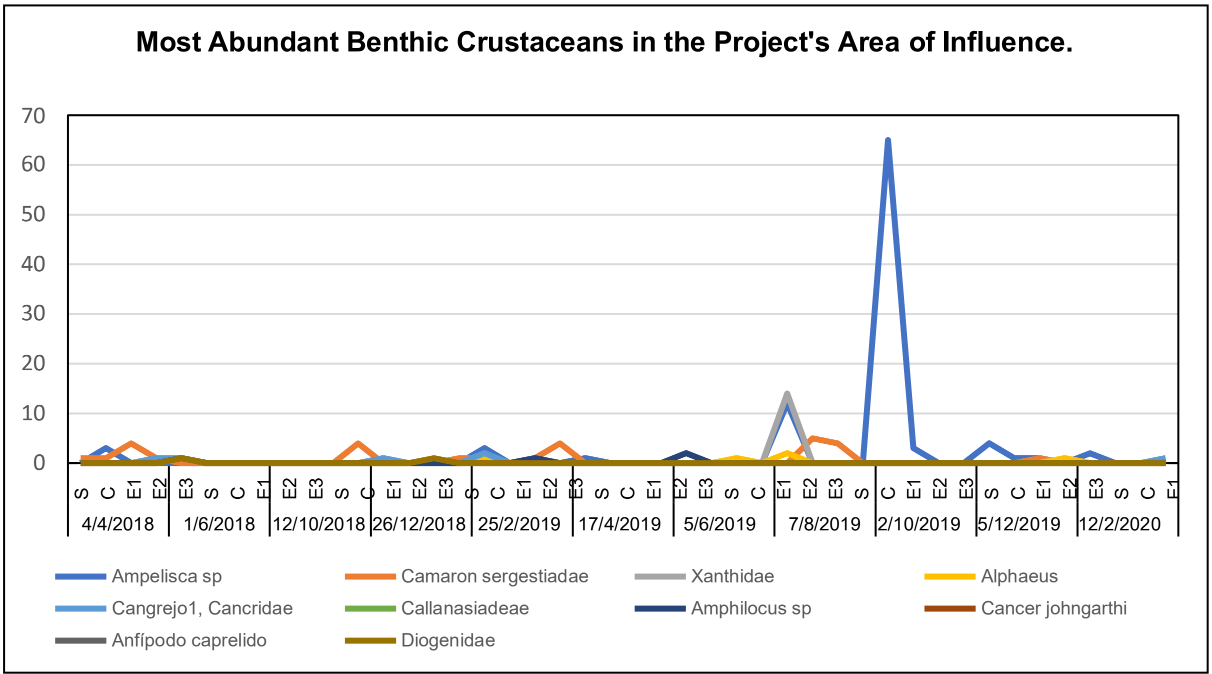
Figure 28. Abundance and Distribution of Benthic Organisms collected with Van Veen Dredge in Puerto Bolívar Project's Area of Influence.



Prepared by: Ecosambito, 2020

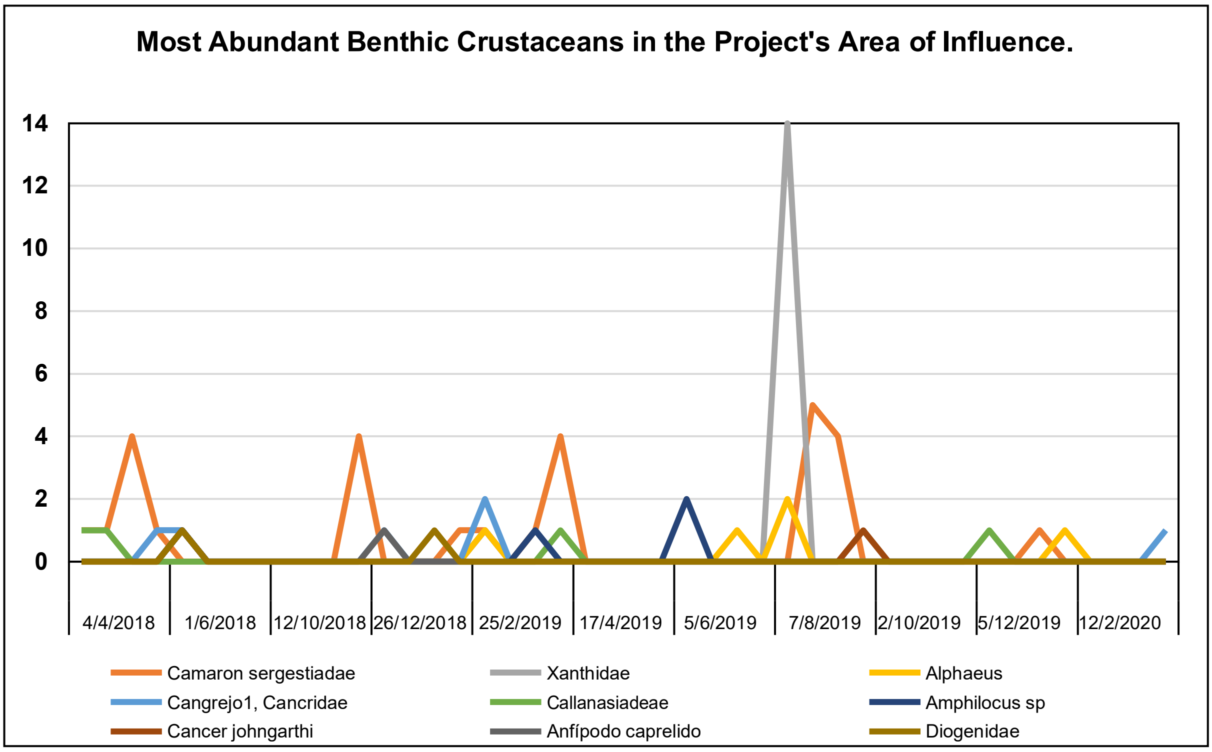
Table 7 communicates the ranking of most abundant benthic beings where the 10 most abundant beings of all collections represented 63% of the total number of individuals counted and the 20 most abundant beings represent 80% of all specimens trapped during the 2018-2020 monitoring. When analyzing the abundance of main zoological groups, figures 29 to 32 are shown.

Figure 29. Abundance of Crustaceans in Monitoring considering the 10 Most Abundant Species



Prepared by: Ecosambito, 2020

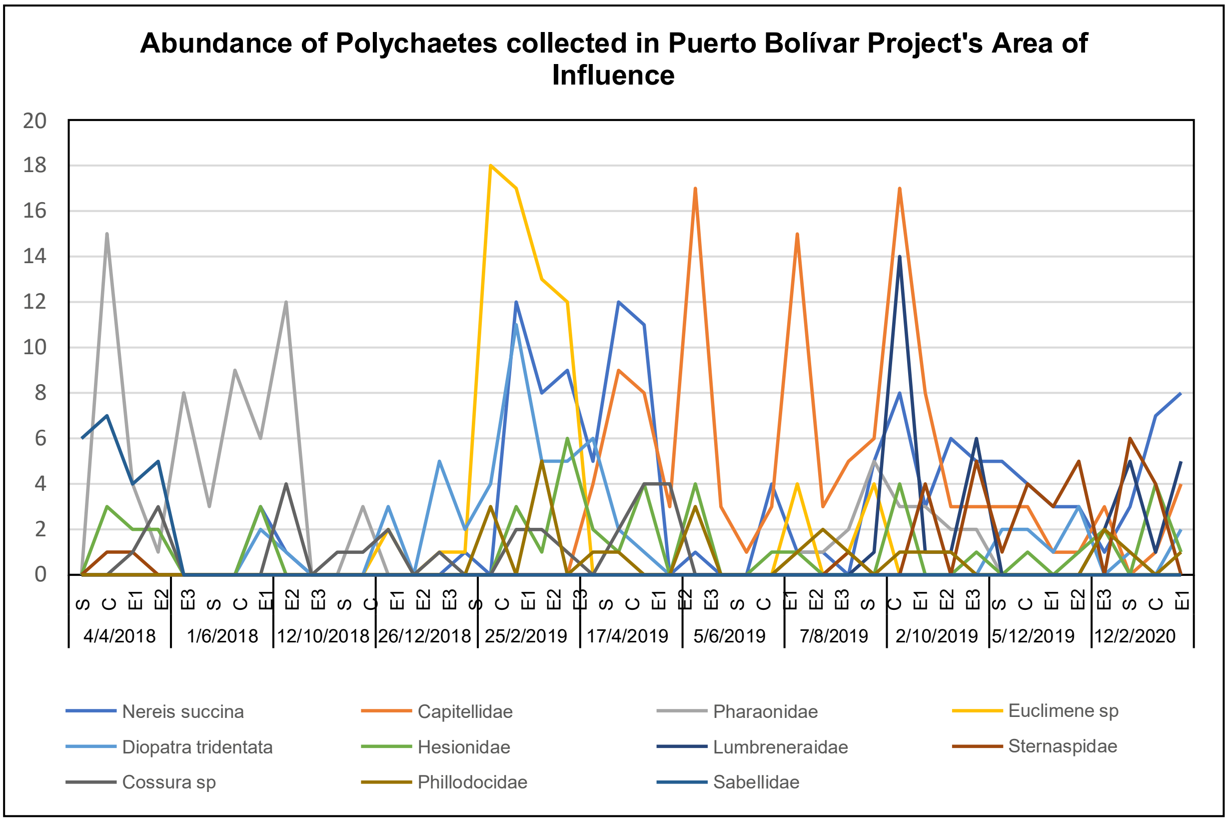
Figure 30. Abundance of Crustaceans in the Project's Area of Influence without considering the Most AbundantSpecies, the Ampelisca sp. (Amphipod)



Prepared by: Ecosambito, 2020

In Figure 29 and Figure 30, it can be seen that there are more crustaceans in the vicinity of Santa Clara Island, while Station E1, located in the deposit basin for dredged material, exhibited the least richness and abundance of such species.

Figure 31. Fluctuations of Polychaetes during the Monitoring Period

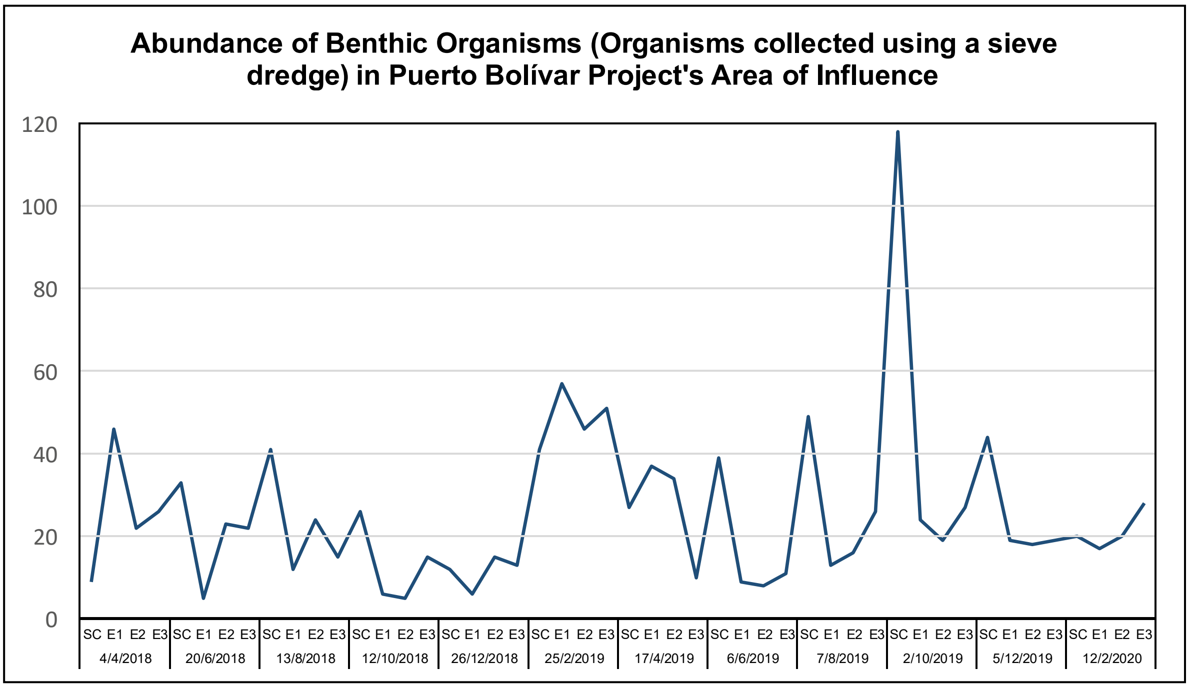


Prepared by: Ecosambito, 2020

Figure 31 shows active fluctuations in the abundance of polychaetes in the area of influence of the Puerto Bolivar Project, with maximum abundance values in the Santa Clara Island station, at this point we suggest a more exhaustive study of this zoological group given its good role as an indicator of seabed quality.

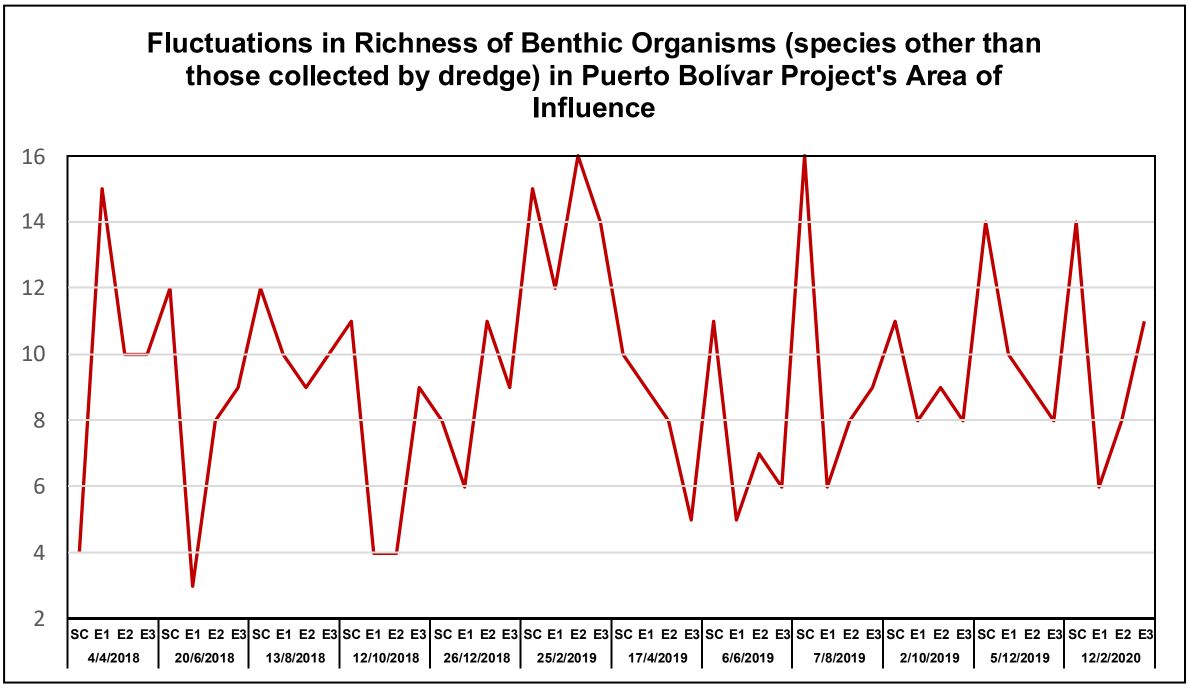
As shown in Figure 32, which integrates the total abundance of benthic beings in all samples, the period of maximum abundance occurred on October 2, 2019, which is attributed to a swarm of Ampelisca sp, as shown in Figure 29.

Figure 32. Abundance of Benthic Organisms in the Project's Area of Influence.



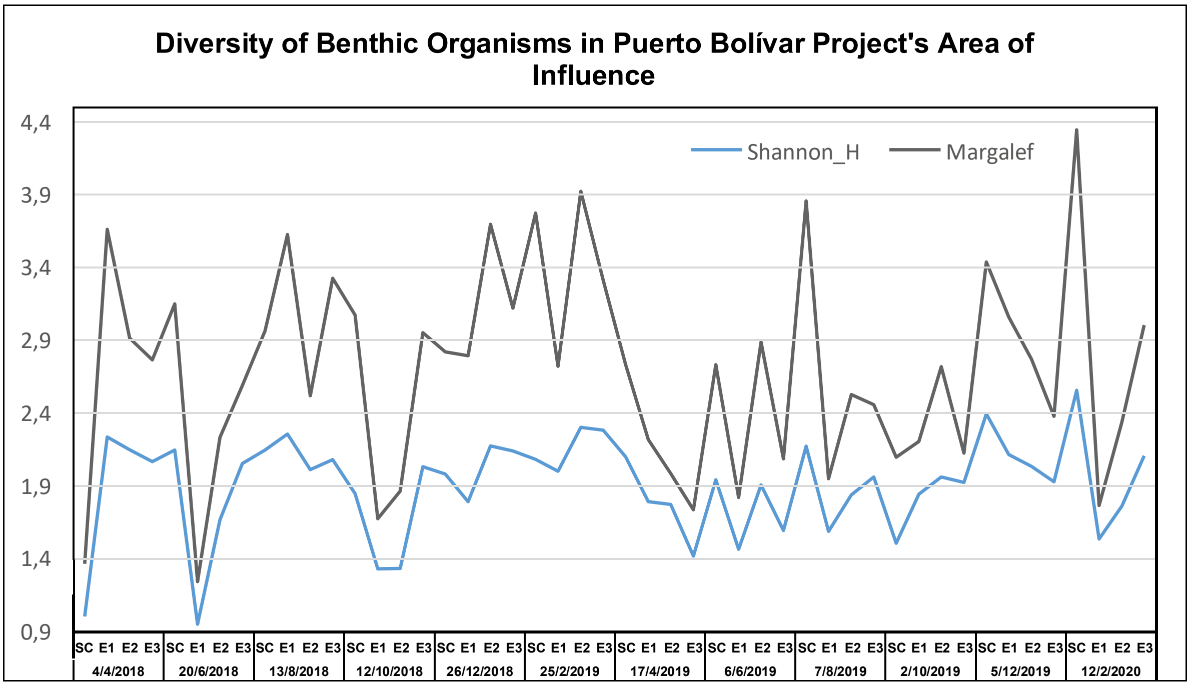
Prepared by: Ecosambito, 2020

Figure 33. Fluctuations in Benthic Richness during 2018-2020 Monitoring



Prepared by: Ecosambito, 2020

Figure 34. Fluctuations in Benthic Diversity

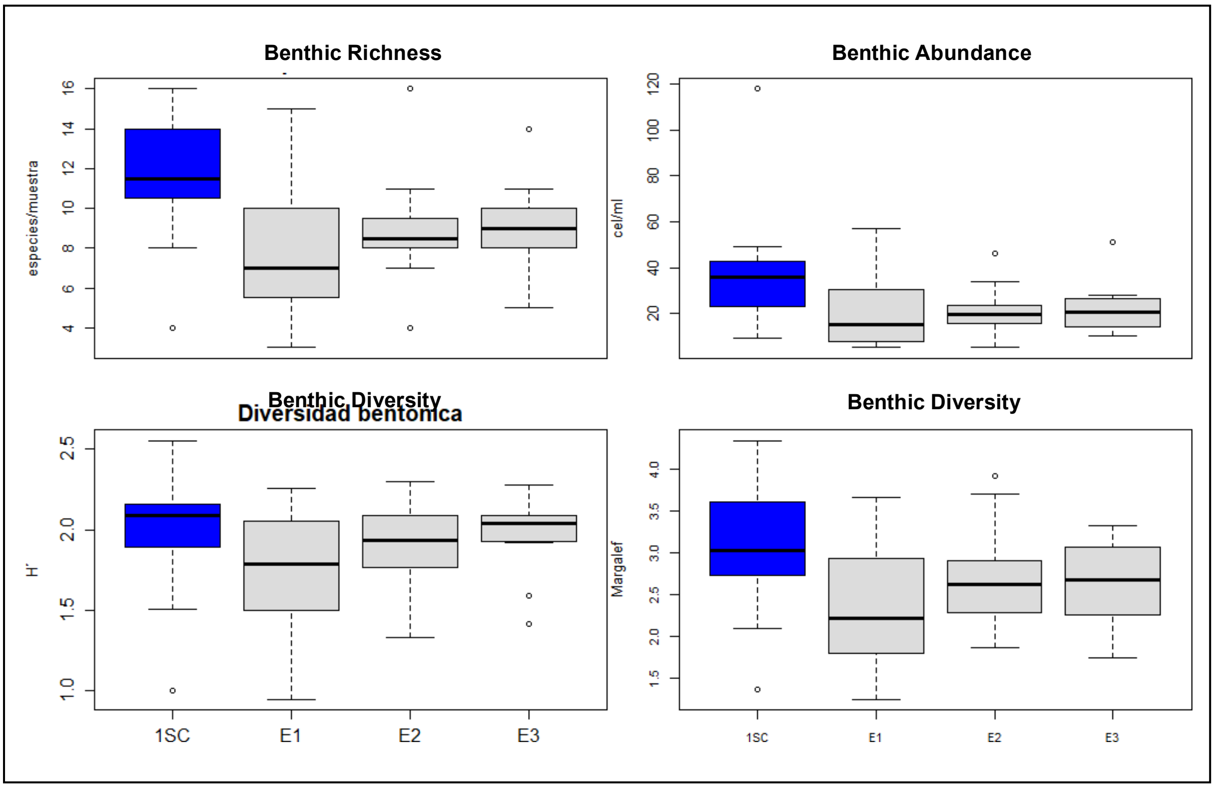


Prepared by: Ecosambito, 2020

Figure 33 and Figure 34 show a drop in richness and diversity in the dredge deposit area during dredging maneuvers, an expected situation since it would have temporarily affected small creatures that were buried under the sediments removed from the access channel and maneuvering area of Puerto Bolivar and were deposited in the bucket. However, it should be noted that not all benthic creatures succumb and the survivors, which we will call "bioengineers", begin to improve the sediment conditions and establish new benthic communities. The benthic community is resilient and hence its usefulness as a bioindicator community of change.

To understand which sites would be most affected by the dredging maneuvers, the general ecological descriptions grouped by analysis site are presented in Figure 35.

Figure 35. General Ecological Descriptors of the Benthic Community collected using 4-Lt and 10-kg Van Veen Dredges with a Sampling Surface Area of 0.08 m2 in the Area of Influence

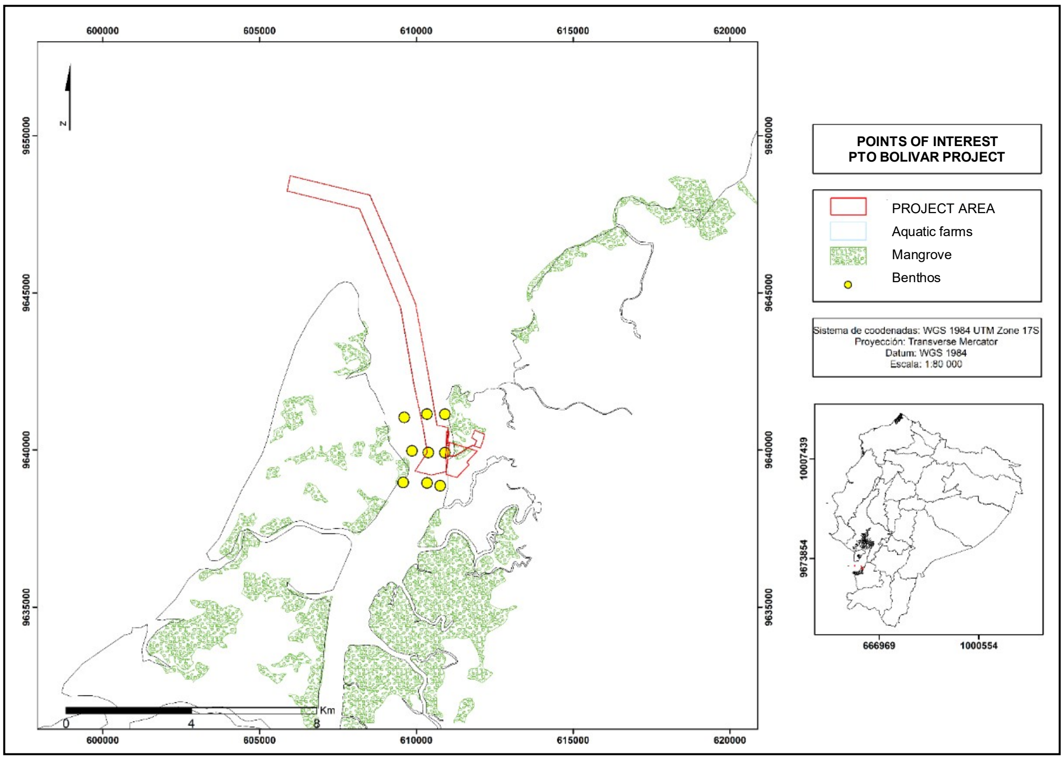


Prepared by: Ecosambito, 2020

Regarding the ecological descriptions of the benthic community, the best descriptions are associated with the most oceanic station, Santa Clara Island, a situation that is attributed to the presence of various types of bottom, since in the samples from this sector, in addition to fine or sandy sediments, the presence of gravels was observed, numerous empty shells and even pebbles of sedimentary material that facilitate the colonization of a greater number of benthic forms, while the sediments of the dredge deposit basin were characterized by silty sediments towards the oceanic sector and with an increase of sand, pyrite and organic plant matter towards the coastal sector.

In view of the lack of samplings related to the area of direct influence in the Santa Rosa estuary, on November 5, samples were acquired in 9 sites inside the Santa Rosa estuary; these are show in Figure 36. The collection method used was the same dredge that had been used in the 2018 - 2020 monitoring.

Figure 36. Benthic Sampling Sites for November 5, 2020Prepared by: Ecosambito, 2020



Prepared by: Ecosambito, 2020

Photographic Record 1. Van Veen Dredge used for Benthic Sampling and Sieving through a 500-Micron Mesh.

Prepared by: Ecosambito, 2020

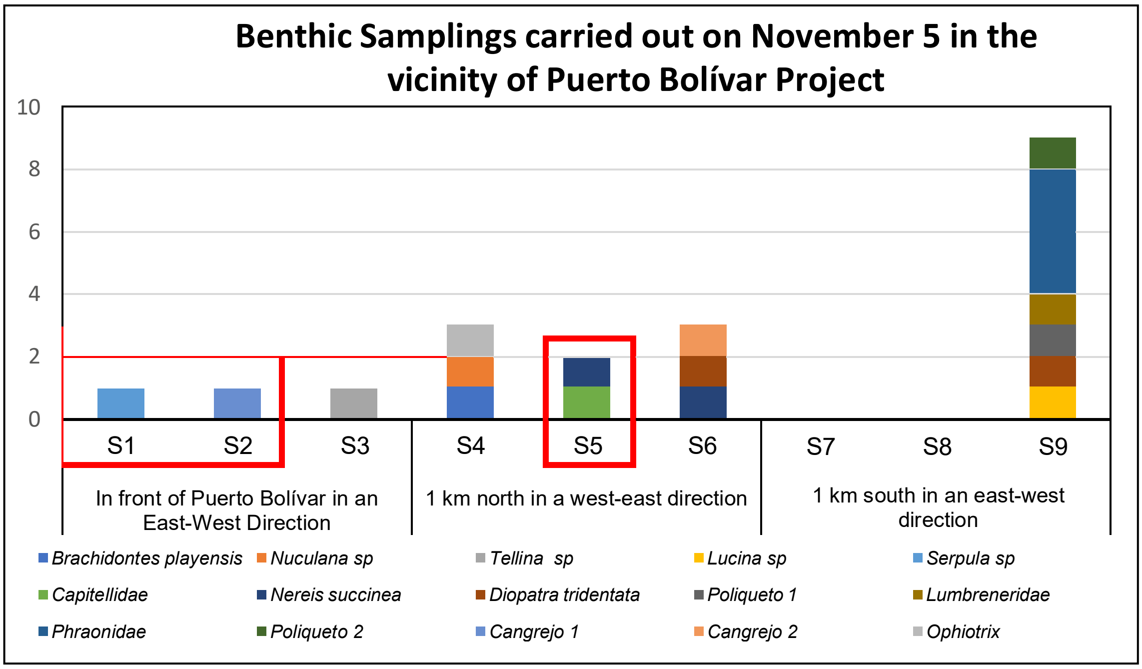
In the nine dredging operations carried out, only 20 benthic creatures of 15 different species were obtained, as well as numerous traces of other creatures, which are shown in Table 8 and Figure 37.

Table 8. Benthic Organisms collected in the Santa Rosa Estuary

Main Group	Type/genus/species	Abundance
Bivalves	*Brachidontes playensis*	1
	Nuculana sp	1
	Tellina sp	1
	Lucina sp	1
Annelida	*Serpula sp*	1
	Capitellidae	1
	Nereis succinea	2
	Diopatra tridentata	2
	Polychaeta 1	1
	Lumbreneridae	1
	Phraonidae	4
	Polychaeta 2	1
Crustacea	Crab 1	1
	Crab 2	1
Echinodermata	*Ophiotrix sp*	1
Total		20

Prepared by: Ecosambito, 2020

Figure 37. Benthic Sampling carried out on November 5 in the Santa Rosa Estuary



Prepared by: Ecosambito, 2020

Figure 37 shows the sites within the maneuvering area and access channel to Puerto Bolivar that have been dredged, which although they have few forms of life corresponding to two crabs and two polychaetes, do not present the worst state of the bottoms of the sector, a situation that occurred south of the Cabotaje dock, where two samples were azoic in the bottoms near the waterfront and middle part of Estero Santa Rosa, however near the sector with mangroves, there was the largest collection of benthic beings.

Photographic Record 2. Unidentified crab collected in the dredge sector of Puerto Bolívar's access channel; 2 were egg-bearing females, indicating a local population.

Prepared by: Ecosambito, 2020

The sample collected near the entrance of Jambelí beach resort, i.e. Point S4, presented 3 forms of life despite mainly consisting of valves and inert shells of mollusks, since there is considerable shell deposition in that place, causing the formation of a shell beach in that sector. The ecological descriptors of the benthic collections carried out on November 5 are shown in Table 9.

Table 9. Ecological Descriptors of Benthic Collections carried out on November 5, 2020

Descriptors	S1	S2	S3	S4	S5	S6	S9
Richness	1	1	1	3	2	3	6
Abundance	1	1	1	3	2	3	9
Dominance_D	1	1	1	0.3333	0.5	0.3333	0.2593
Simpson_1-D	0	0	0	0.6667	0.5	0.6667	0.7407
Shannon_H	0	0	0	1.099	0.6931	1.099	1.581
Evenness_e^H/S	1	1	1	1	1	1	0.81
Brillouin	0	0	0	0.5973	0.3466	0.5973	1.069
Menhinick	1	1	1	1.732	1.414	1.732	2
Margalef	0	0	0	1.82	1.443	1.82	2.276
Equitability_J	0	0	0	1	1	1	0.8824
Fisher_alpha	0	0	0	0	0	0	7.867
Berger-Parker	1	1	1	0.3333	0.5	0.3333	0.4444

Prepared by: Ecosambito, 2020

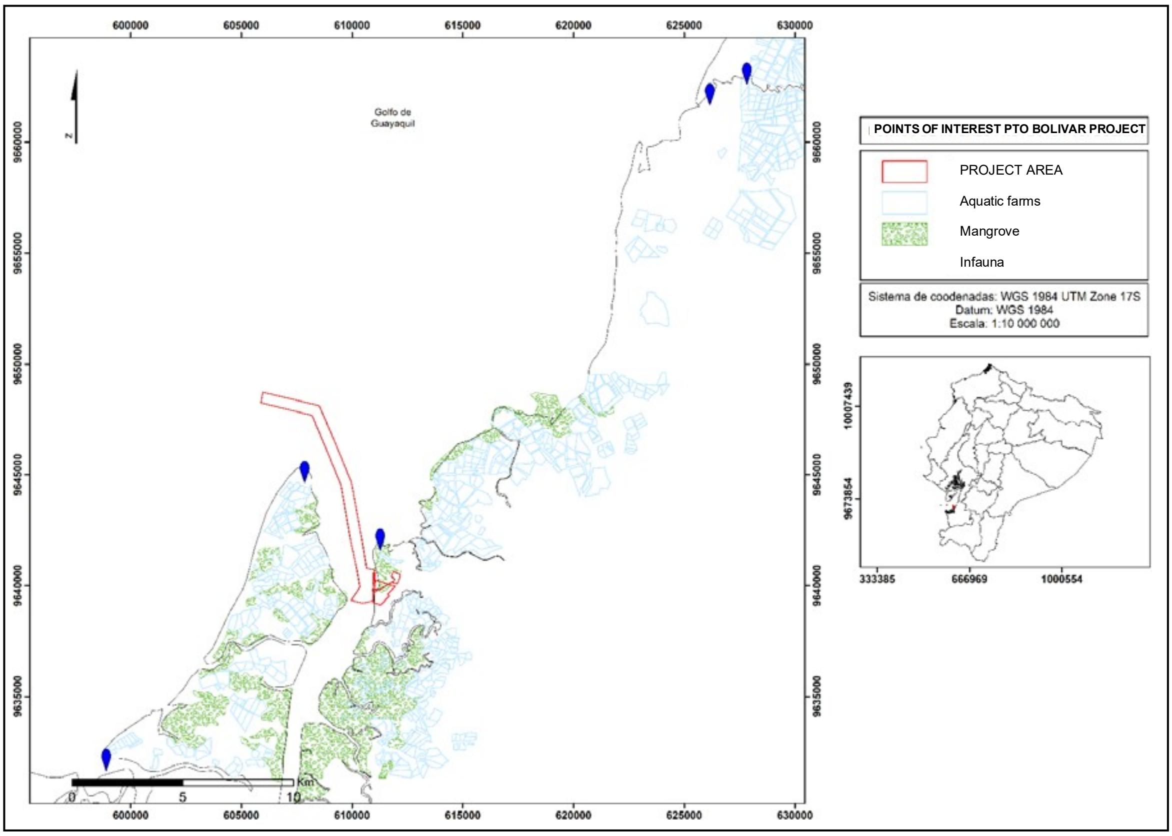
The ecological descriptions of the benthic collections show the existence of poor environmental quality conditions, an expected situation since the sediments and their life forms show cumulative impacts of different pressures such as untreated urban discharges where there will be high levels of organic compounds that will become limiting for life, the excess accumulation of organic matter decreases the oxygen levels of the sediment-water interface, becoming anoxic and even toxic. Although this situation was not confirmed in the laboratory, it was evidenced by the "rotten egg" odor of most of the stations, characterized by black sediments that denote the generation of compounds associated with sulfides and that would surely present very negative redox values.

3.5 Infauna Community

Although the infauna community was not considered in the 2017 EIA, the consulting team conducted sampling at a site near the Puerto Bolivar Project, specifically in the exposed intertidal sector called Playa Isla del Amor where it is common to observe people extracting bivalves and 4 more reference sites were located, To the north, two soft bottom sectors of the Puntilla locality called Puntilla islote also exposed to the Jambelí Channel and Puntilla interna that corresponds to beaches of sheltered sectors on the southern shore of this mouth. Towards the southern limit, Pongalillo beach was chosen, which is exposed towards the coast and shows evident signs of mangrove loss; and the exposed Jambelí beach a few meters from the lighthouse at the entrance to Santa Rosa, three of these locations correspond to muddy beaches with intertidal strips that remain exposed at low tide while Jambelí has fine sand. The location of sampling sites is shown in Figure 37. Location of infauna sampling sites, which were chosen due to the availability of previous data in the same sectors in 2013.

In these samplings, the length of the beach is estimated perpendicular to the main body of water that bathes it and, depending on the size of the beach, 10 equidistant analysis "stations" are established in the ideal situation, starting from the low flooded level to its upper end. In each station a hole is dug to quickly check the sand removed from it as the depth increases, this hole hardly exceeds 80cm because immediately the interstitial water or waves that arrive to it, demolish its contours and in a matter of minutes you have a small shallow pool. When counting the beings collected, it is possible to establish ecological descriptions where the richness of resources stands out.

Figure 38. Location of Beaches where the Infauna was analyzed.



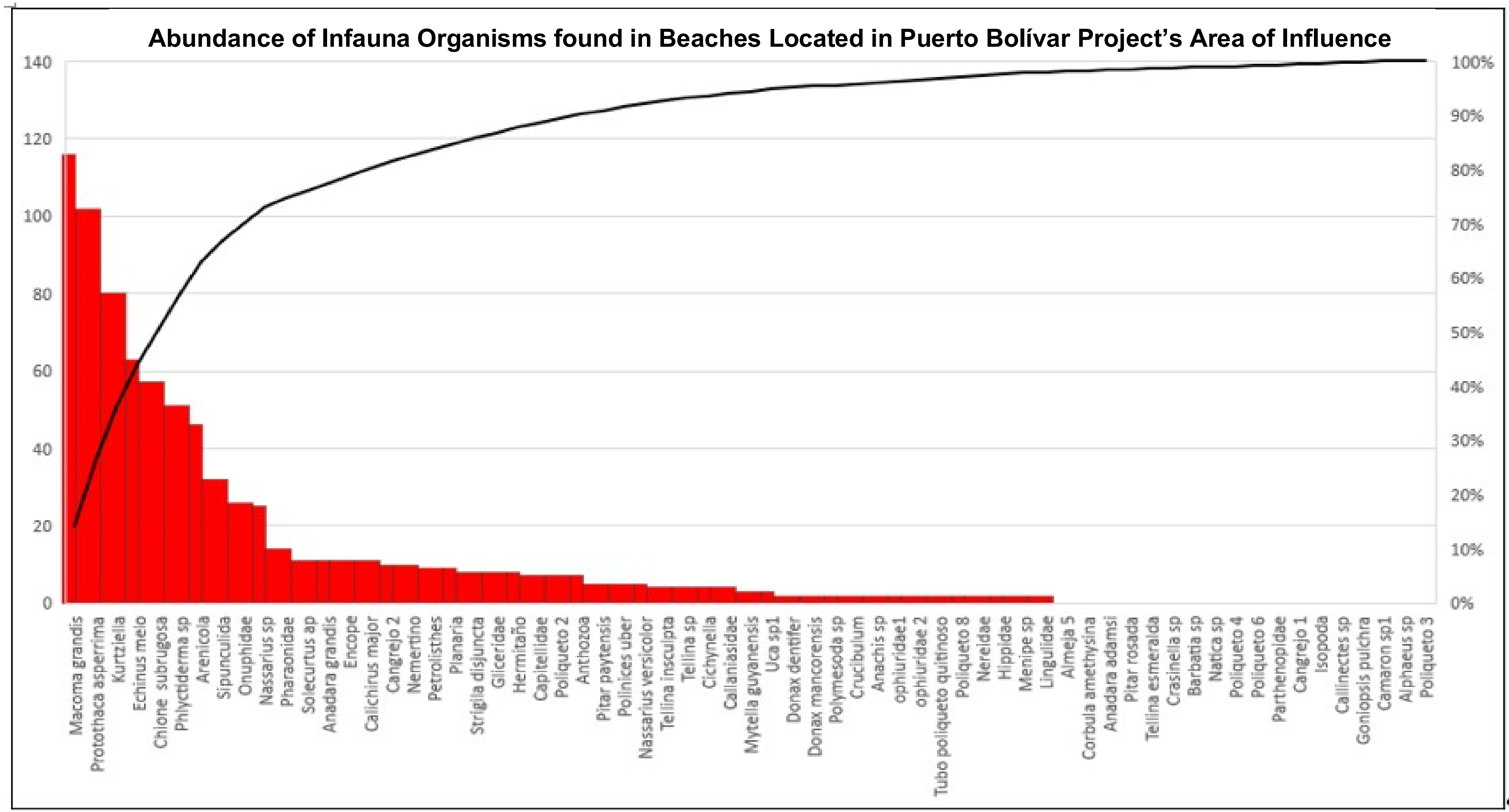
Prepared by: Ecosambito, 2020

Photographic Record 3. Infauna Sampling in Playa Isla del Amor, October 29, 2020

Prepared by: Ecosambito, 2020

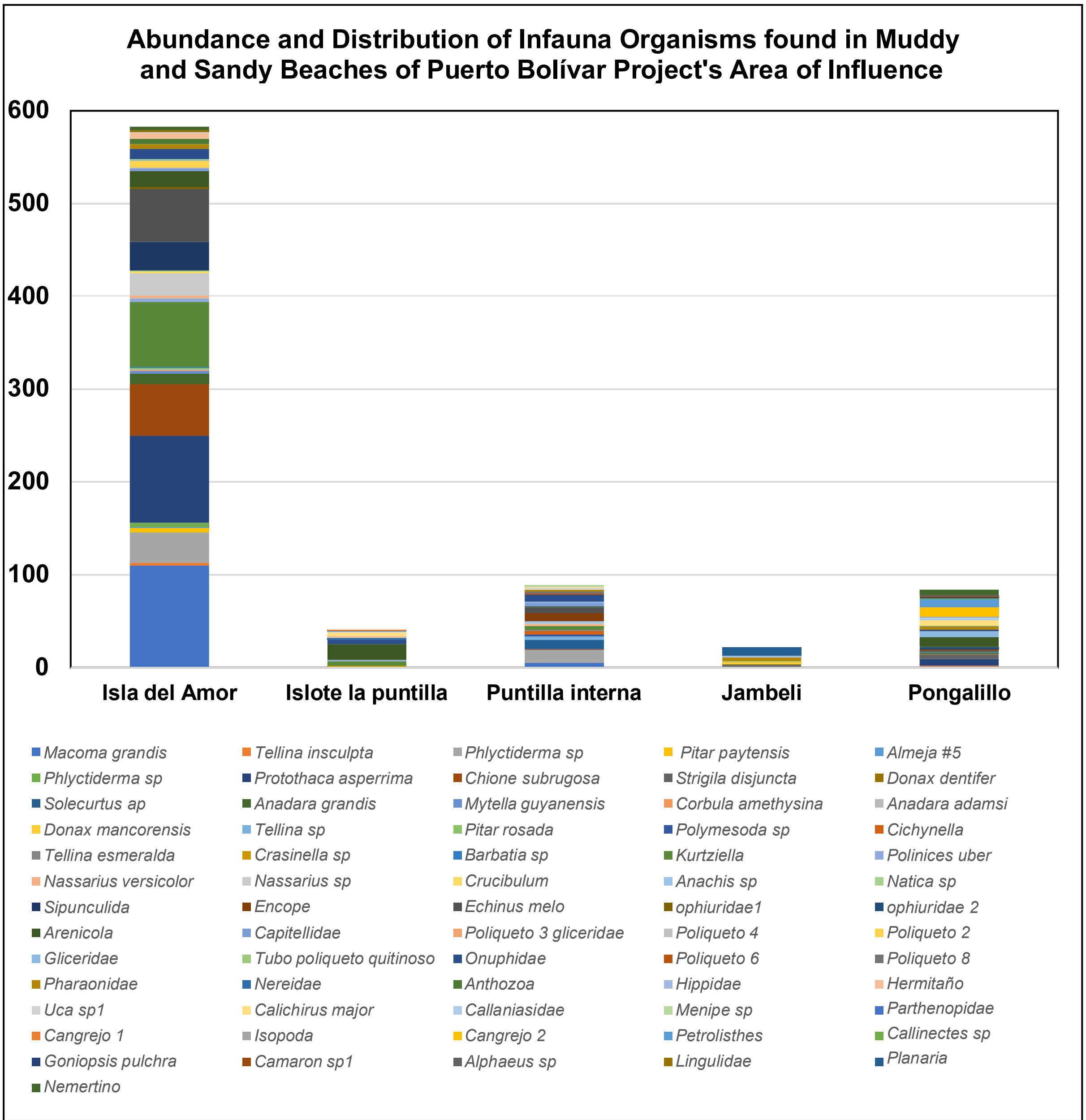
A total of 819 individuals of at least 66 species were collected in the infauna sampling: 23 bivalve mollusks, 7 gastropods, 1 sipunculid, 4 echinoderms, 12 polychaetes, 1 cnidarian, 15 crustaceans, 1 brachypod, 1 flatworm and 1 nemertean. The abundance and sectorial distribution of the collected organisms are shown in Figure 39 and Figure 39, respectively.

Figure 39. Most Abundant Infauna Organisms in the Project's Area of Influence



Prepared by: Ecosambito, 2020

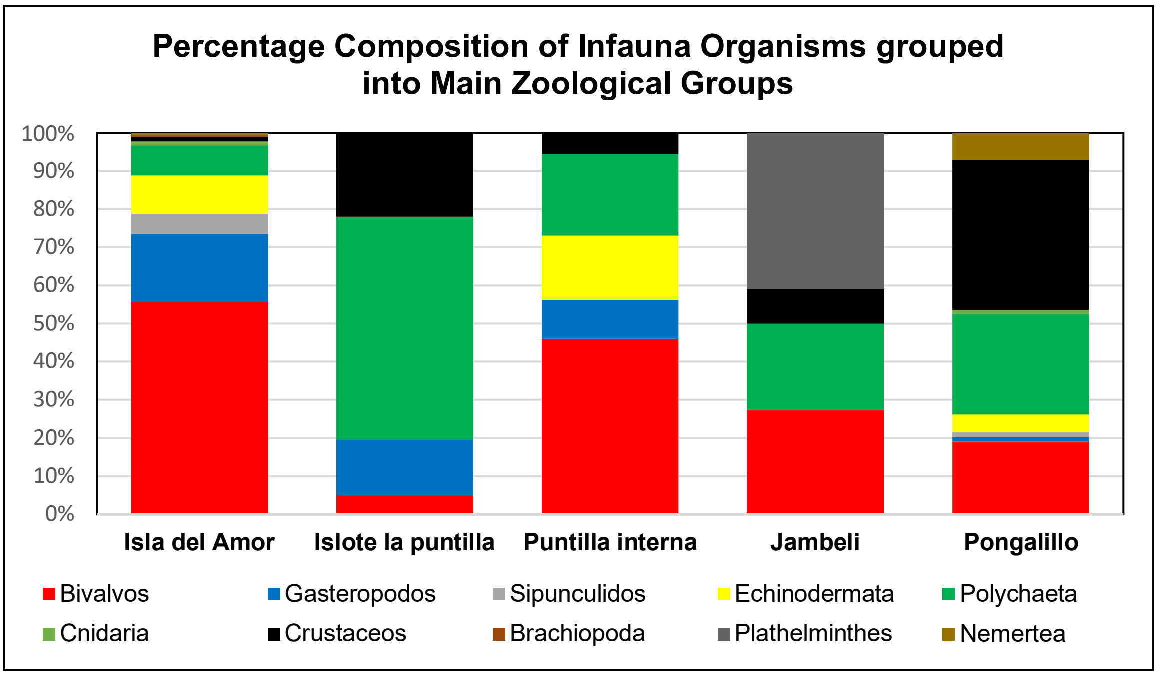
Figure 40. Abundance and Distribution of Infauna Organisms found in Beaches located in the Area of Influence



Prepared by: Ecosambito, 2020

Figure 40 shows a greater abundance of infauna on the Isla del Amor beach, the sector closest to the Puerto Bolivar Project. This beach is practically a biofilter of the excess of Séston from the Santa Rosa estuary and the outlet of the Dos Bocas stream, being really abundant in bivalves, burying urchins and sipunculids, which were observed in smaller proportions on the other beaches, being replaced mainly by crustaceans, polychaetes and flatworms, as shown in Figure 41.

Figure 41. Composition of Infauna Animals found in the Muddy and Sandy Beaches of the Area of Influence.



Prepared by: Ecosambito, 2020

The ecological descriptors of the infauna community are presented in Table 10. They reveal the existence of an intermediate diversity in Playa Isla del Amor, La Puntilla internal sector and Playa Pongalillo. This is close to a condition of high diversity in the Shannon index (when 3.00 bits are exceeded) and, with respect to the Margalef index, these three beaches appear to have a high diversity, understanding them as sectors of good environmental quality because they exceed the value of 5. In the opposite situation, Playa Jambelí and Islote La Puntilla are closer to low diversity values. In the case of the former, this condition is attributed to the abrasive effect of the fine sand, while the islet presents an excess of shells and under them muds that are anoxic at first sight.

Table 10. Ecological Descriptors for the Infauna of the Beaches analyzed in the Project's Area of Influence.

Descriptor	Isla_del_Amor	Islote_la_puntilla	Puntilla_interna	Jambeli	Pongalillo
Richness	36	12	24	7	25
Abundance	583	41	89	22	84
Dominance_D	0.1049	0.2195	0.07587	0.2397	0.07455
Simpson_1-D	0.8951	0.7805	0.9241	0.7603	0.9255
Shannon_H	2.626	1.943	2.836	1.664	2.837
Evenness_e^H/S	0.3839	0.5819	0.7105	0.7546	0.6828
Brillouin	2.524	1.619	2.483	1.332	2.467
Menhinick	1.491	1.874	2.544	1.492	2.728
Margalef	5.496	2.962	5.124	1.941	5.417
Equitability_J	0.7328	0.7821	0.8924	0.8553	0.8815
Fisher_alpha	8.481	5.709	10.79	3.544	12.04
Berger-Parker	0.1887	0.4146	0.1573	0.4091	0.131

Prepared by: Ecosambito, 2020

Among the 66 benthic infauna in the area of influence, none show populations of concern except for the genus of the burying urchin Echinus melo, which appears as near threatened, NT, the clam Polymedosa inflata appears in the LC category (low concern) and two more snails of the Nassaridae family appeared with insufficient data in the DD category. There are no vulnerable or critically endangered species in this community, although it should be noted that there are very few population studies of marine resources that lack commercial value.

3.6 Ichthyofauna

The ichthyofauna of the sector of influence was exclusively monitored at 4 sites (the same as the benthos sites) at sea. At each sampling site, fishing was carried out with standardized effort that consisted of a set of a 3.5" electro-welded plastic monofilament net, two cloths long, which was left to work for 30 minutes from the moment the watering of the gear was finished.

At this point, it is important to highlight the importance of fishing in the local context, with an estimated 3,000 fishermen engaged in extractive work, motorized coastal artisanal fishing is carried out practically throughout the Jambelí channel and coastal waters of the Jambelí archipelago, as well as in the vicinity of Santa Clara Island.

In the high seas fishing records for the period 2018 to 2020, the capture of 53 fish and 4 crustaceans was reported, also releasing 5 species of international concern of batoids, 4 of them registered in IUCN Redlist:

- White-horned guitarfish Rhinobatus leucorhynchus (VU)
- Pygmy manta ray Mobula munkiana (VU)
- Duck ray Mylibatis longirostris (VU)
- Beaked skate Urotrygon rogersii
- Rostroraja equatorialis rays (VU).

Figure 42 and Figure 43 show the total estimate of resources captured and their temporal evolution, figures from which it can be seen that Peprilus medius or Redfish was the most captured resource and its maximum record was 117 pieces on June 6 in the vicinity of Santa

Clara Island. The 10 most abundant resources in terms of the number of fish caught represented 80.95% and the 20 most caught resources represented 92.59% as shown in Table 11.

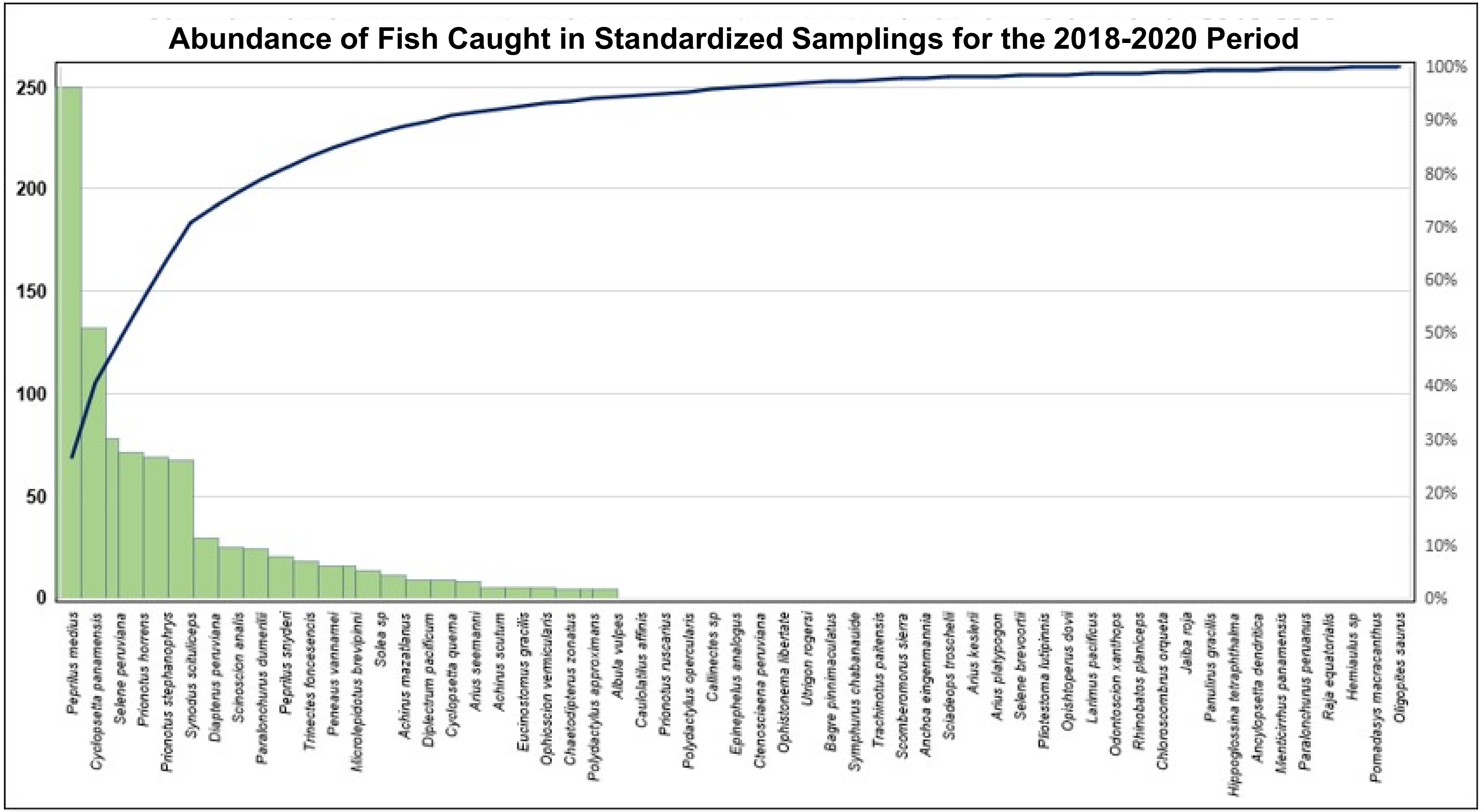
When considering fisheries conducted with atarray in the period 2019 (Figure 44), the record of species increases a total of 71 species of fish caught in period 2018 - 2020, within which appeared 4 more species of international concern and that in the same way were released in good condition and that were:

- Seahorse Hippocampus ingens (VU).
- Flat Guitarfish Rhinobatos planiceps (VU)
- 2 types of thornback ray Raja sp (VU)

Photographic Record 4. Peprilus medius or Pacific harvestfish, the resource that was most frequently caught in the high seas during the 2018-2020 period in Santa Clara Island and in the deposit basin for dredged material.

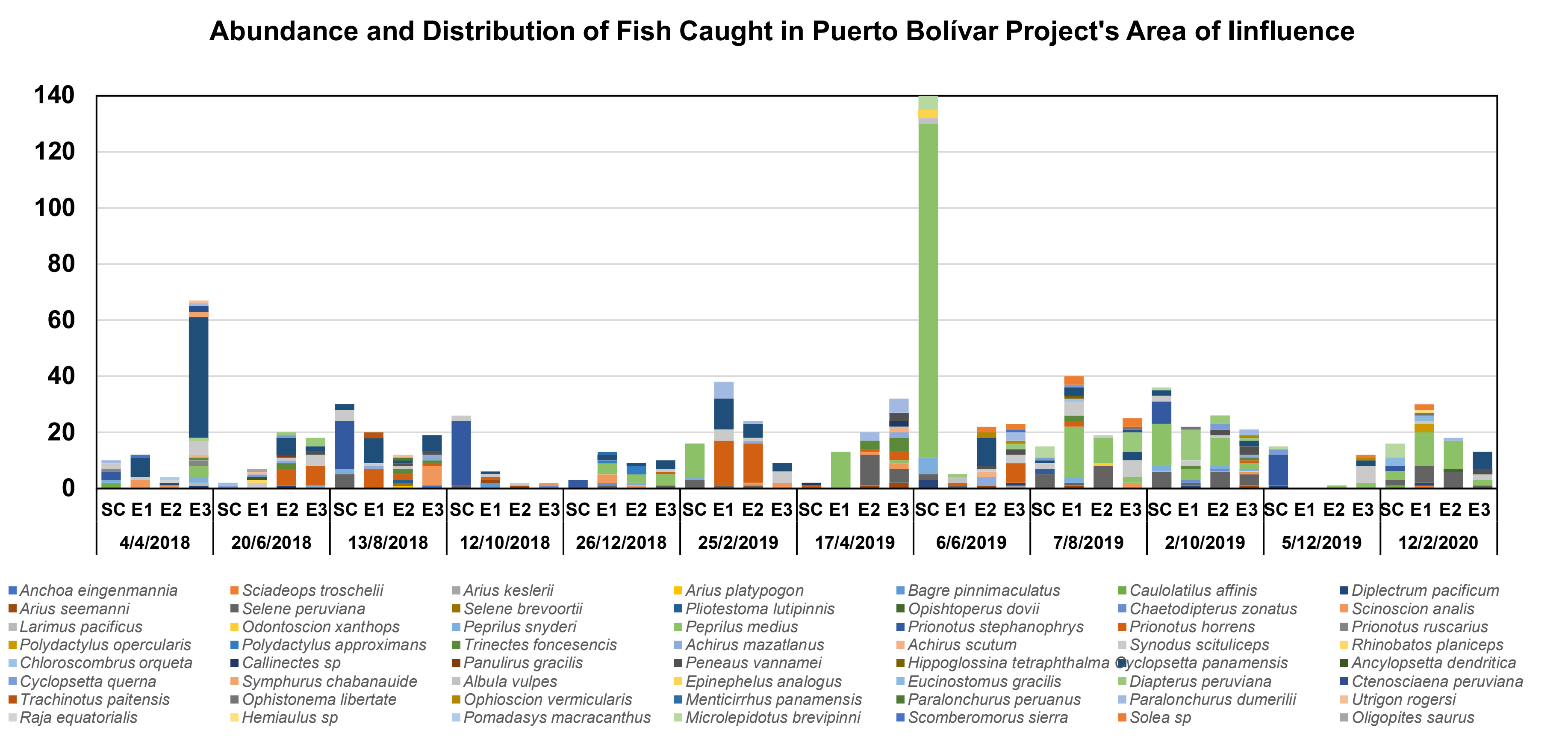
Prepared by: Ecosambito, 2020

Figure 42. Numerical Composition of Catches during the 2018-2020 Period in Puerto Bolívar Project's Area of Influence. Prepared by: Ecosambito, 2020



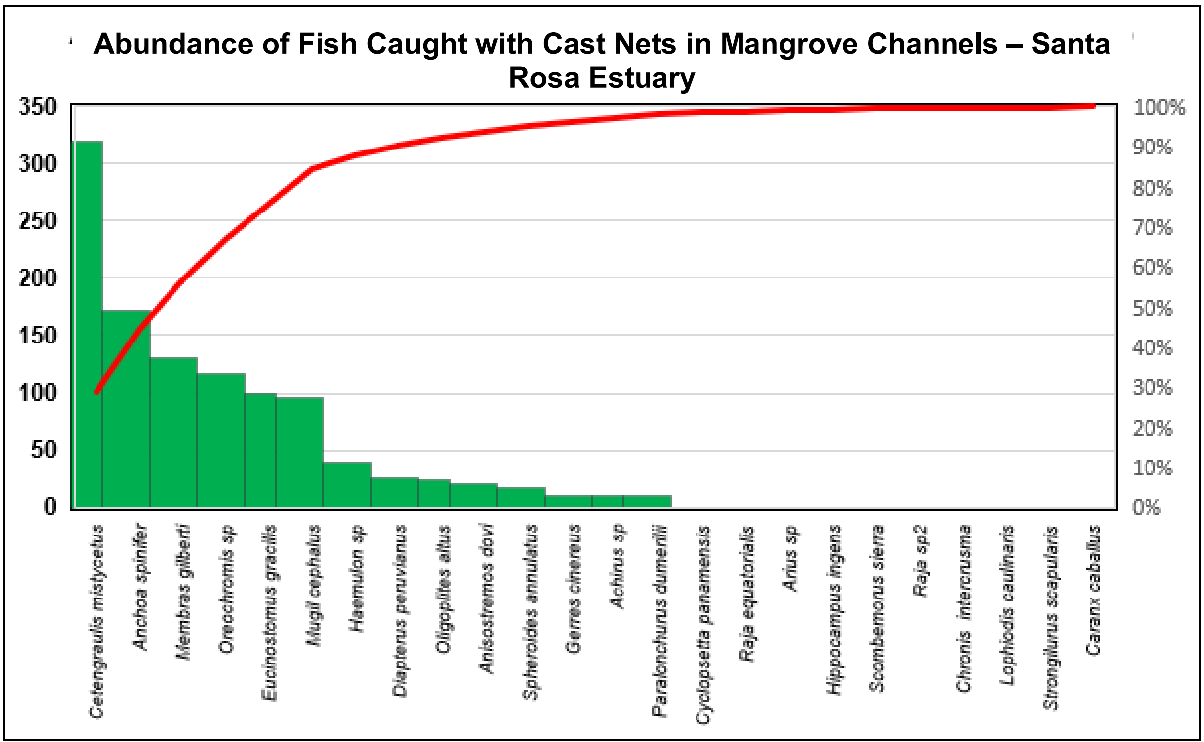
Prepared by: Ecosambito, 2020

Figure 43. Abundance and Distribution of Catches of Fish and Crustaceans during the 2018–2020 Period



Prepared by: Ecosambito, 2020

Figure 44. Main Juvenile Fish Species caught with Cast Nets in Mangrove Channels and Main Water Body of the Santa Rosa Estuary



Prepared by: Ecosambito, 2020

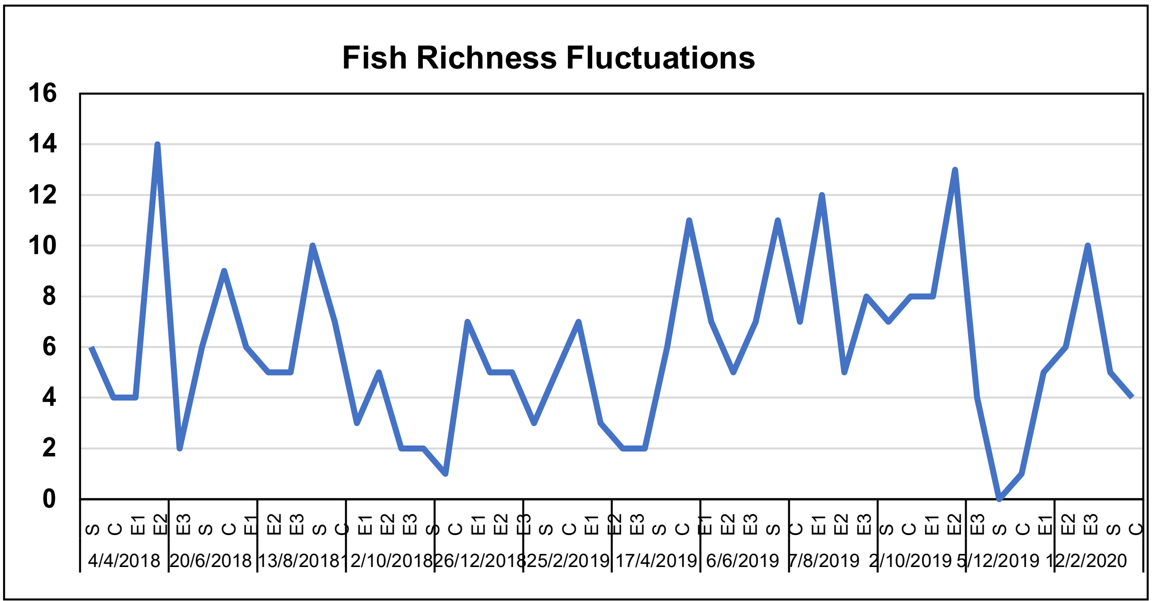
Table 11. The 20 Most Caught Resources in Terms of Abundance in the Area of Influence of the Deposit Basin for Dredged Material according to 2018-2020 Records

No.	***Scientific Name***	**Individuals Caught**	**Relative Abundance %**
1	*Peprilus medius*	250	26.46%
2	*Cyclopsetta panamensis*	132	13.97%
3	*Selene peruviana*	78	8.25%
4	*Prionotus horrens*	71	7.51%
5	*Prionotus stephanophrys*	69	7.30%
6	*Synodus scituliceps*	67	7.09%
7	*Diapterus peruviana*	29	3.07%
8	*Cynoscion analis*	25	2.65%
9	*Paralonchurus dumerilii*	24	2.54%
10	*Peprilus snyderi*	20	2.12%
11	*Trinectes foncesencis*	18	1.90%
12	*Peneaus vannamei*	16	1.69%
13	*Microlepidotus brevipinni*	16	1.69%
14	*Solea sp*	13	1.38%
15	*Achirus mazatlanus*	11	1.16%
16	*Diplectrum pacificum*	9	0.95%
17	*Cyclopsetta querna*	9	0.95%
18	*Arius seemanni*	8	0.85%
19	*Achirus scutum*	5	0.53%
20	*Eucinostomus gracilis*	5	0.53%

Prepared by: Ecosambito, 2020

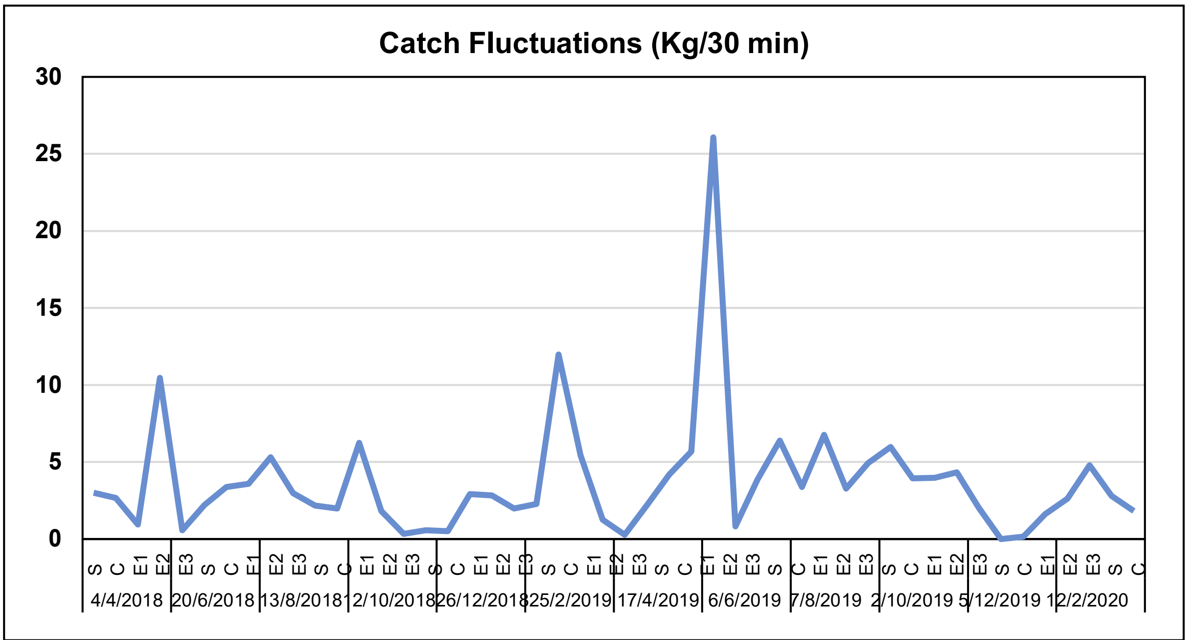
Fluctuations in resource richness, biomass caught and catch diversity indices for the 2018-2020 monitoring period are illustrated in Figures 45 to 47. Figure 47 shows that, in all fishing monitoring campaigns, the greatest richness of species caught occurred within the deposit basin for dredged material and, in general terms, there is a greater presence of different species between the second and third quarters of each year, i.e. in the winter-summer transition of the Ecuadorian coast and it is likely that this sector corresponds to an ecotone between oceanic and coastal ichthyic communities.

Figure 45. Richness of Resources Caught in the High Seas during the 2018-2020 Period



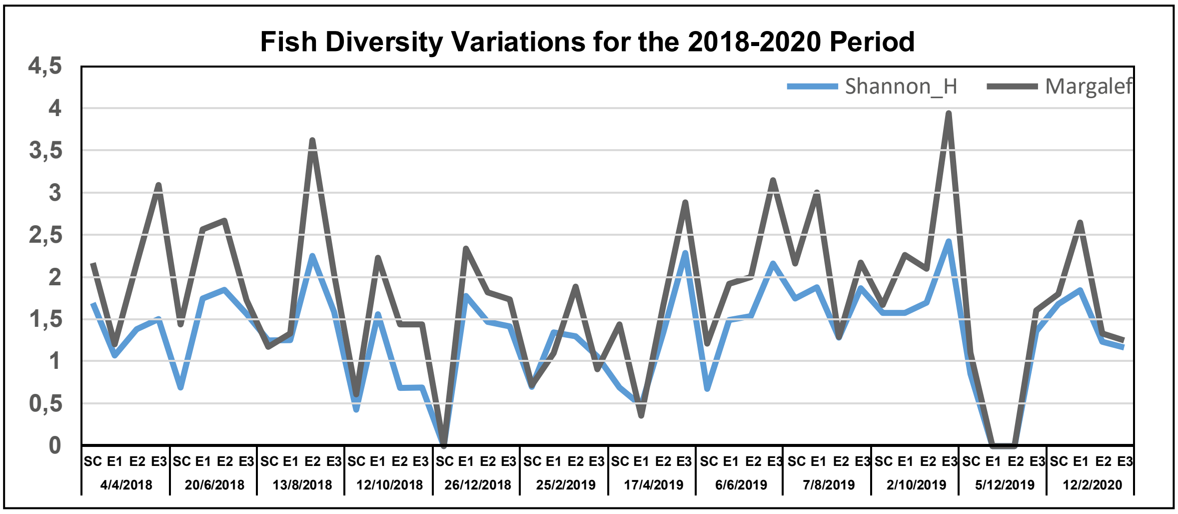
Prepared by: Ecosambito, 2020

Figure 46. Total Catch Variations by Station (Kg/30 min)



Prepared by: Ecosambito, 2020

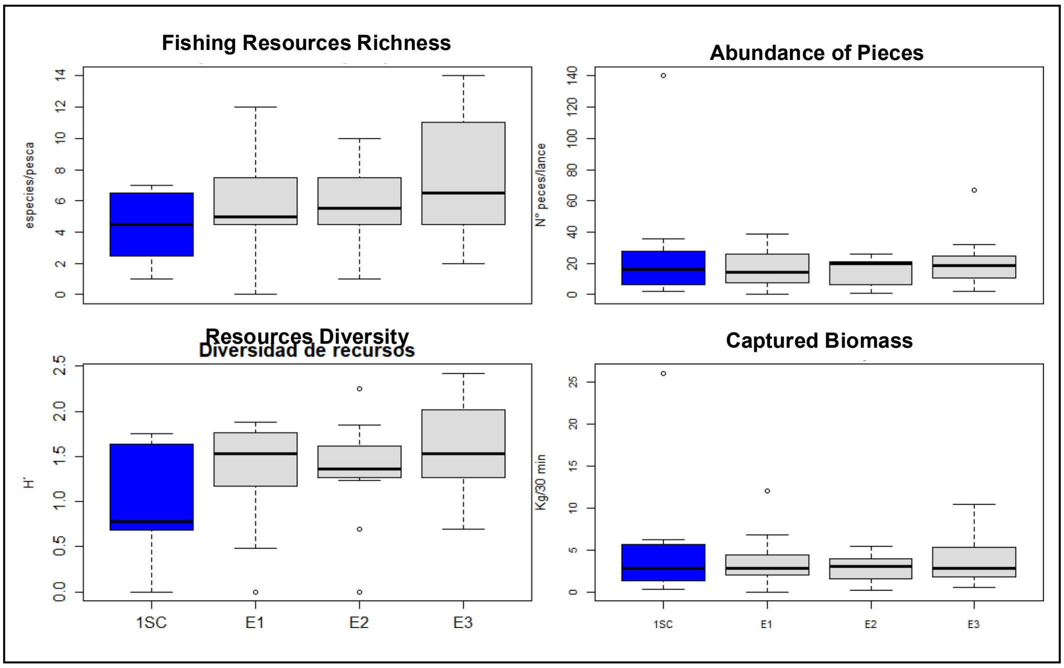
Figure 47. Fluctuations in Diversity of Fishing Resources Caught



Prepared by: Ecosambito, 2020

As regards the biomass captured at each site, Figure 46 shows that the highest catches occurred during the fishing activities carried out near Santa Clara Island, which has the category of Marine Reserve. When analyzing the diversity of catches, this community recorded values ranging from low to medium diversity and3 fisheries were unsuccessful, i.e. there were no catches. Figure 48 shows the differences between sampling sites by integrating these values into a database and analyzing them.

Figure 48. Ecological Descriptors of Fish Caught in the High Seas during the 2018-2020 Period.



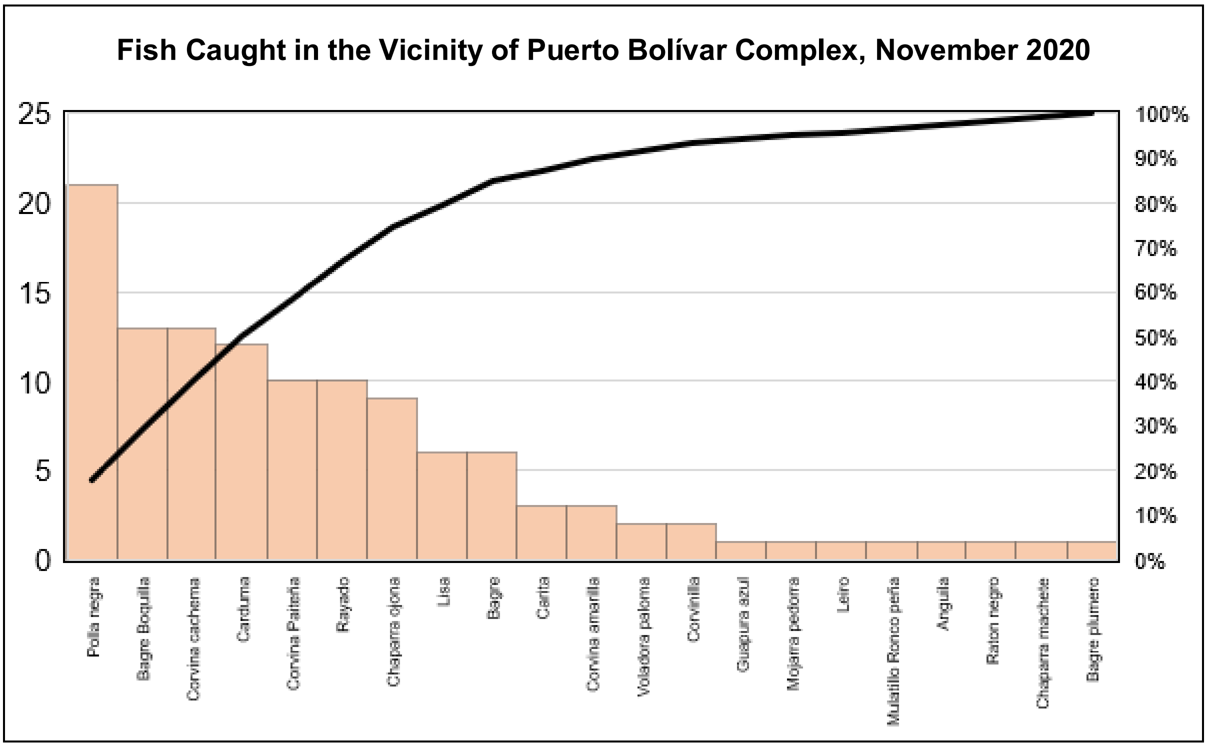
Prepared by: Ecosambito, 2020

After reviewing the 2017 EIA document, which reported the presence of 9 species of fish in the area near the Puerto Bolivar Project where 3 sets were made with 3.5" mesh without specifying the number of cloths used or the working time of the gear and which resulted in the capture of 117 pieces being the most abundant species the corvina cachema Scinoscion analis followed by the Lisa Mugil cephalus, it was decided to observe the evolution of the presence of fish in the vicinity of the Project, On November 4, two simultaneous fishing operations of only 20' duration were carried out using nets with 2¾" mesh eyes and eight long cloths, coordinating with local fishermen who, based on their expertise, decided to make "bowling" type casts, that is to say, they emulated a seine net by spreading the net in a circular fashion and then retrieving it. This method works because most of the species have demersal behavior and being enclosed makes it difficult for them to escape. Photographic Record 5 shows images of the catches made and Figure 49 and Table 12-Table 1 describe the total catch of fish as well as the ecological descriptions.

Photographic Record 5. Fishing operations carried out in the vicinity of Puerto Bolívar.

Prepared by: Ecosambito, 2020

Figure 49. Abundance of Fishing Resources Caught in the Vicinity of Puerto Bolívar



Prepared by: Ecosambito, 2020

Table 12. Ecological Descriptors of Fish Catches in the Vicinity of the Project

Descriptor	Mi_trigueñita	Don_julio_II
Richness	14	15
Abundance	60	58
Dominance_D	0,1056	0,1445
Simpson_1-D	0,8944	0,8555
Shannon_H	2,4	2,255
Evenness_e^H/S	0,7871	0,6355
Brillouin	2,09	1,94
Menhinick	1,807	1,97
Margalef	3,175	3,448
Equitability_J	0,9093	0,8326
Fisher_alpha	5,743	6,56
Berger-Parker	0,1833	0,2759

Prepared by: Ecosambito, 2020

When considering the catches made in the vicinity of Puerto Bolívar, including the standardized catches in the high seas, the casts using cast nets, and the catches near Puerto Bolívar, the catch richness is 72 species of 21 fishes. The ecological descriptors of the catches in the vicinity of Puerto Bolívar on November 4 place this body in a condition of intermediate diversity.

3.7 Seabirds

No specific update study was available for this group of animals; therefore, this baseline used records of previous interventions carried out in 2013 by ornithologist Francisco Sornoza during the 2D seismic prospecting conducted in the Jambelí channel and archipelago and in the Santa Clara island. In these interventions, seabird species were identified, inventoried and photographically recorded, determining the abundance, diversity, density and populational trend of the recorded birds with the greatest importance in terms of their aggregations and fishing activity, and bioindicator species were also identified. During such study, seabird watching tours as well as seabird identification and geo-referencing activities were carried out. The sites were toured on an 8.5 m fiber with a Yamaha 75 Hp engine in the “Prior to the operations” phase (October 6 to 10, 2013), “During the operations” phase (November 11 to 15 and November 29 to December 1, 2013) and “After the operations” phase (December 16 to 22, 2013).

Species richness in the Jambelí channel and archipelago, Puna Island and Santa Clara Island totaled 104, corresponding to 18 orders and 41 families. The order with the largest number of species was Charadriiformes (38), followed by Passeriformes (22) and Pelecaniformes (10). The family with the largest number of species was shorebirds or Scolopacidae with 18 species. Another family with a representative number of species was Ardeidae (9), followed by Charadriidae and Laridae (6).

Table 13 and Table 14 show the data compiled from such study, having selected sites that would be part of the Project's current area of influence, in addition to Santa Clara Island, which is outside the radius of influence of the offshore deposit basin for dredged material.

Table 13. Estimation of Seabird Species Richness in the Project Area in 2013 (Ecuambiente 2013)

Site	Species*	Families	Orders
Southwest Zone			
Cruce del Bravo	36	21	9
Estero La Calavera	29	17	7
Bajo de Pongalillo	8	6	5
Isla del Amor	15	10	5
Faro de Jambelí	23	15	6
Islet in front of Puerto Bolívar	19	13	7
Santa Clara Island			
Santa Clara Island and boulders	12	8	5
Bajo del Burro	8	5	4
Northeast Zone			
Río Jubones	50	27	12
La Puntilla	53	28	15

* Includes species recorded through direct observation and singing and unidentified species – Prepared by: Ecosambito, 2020

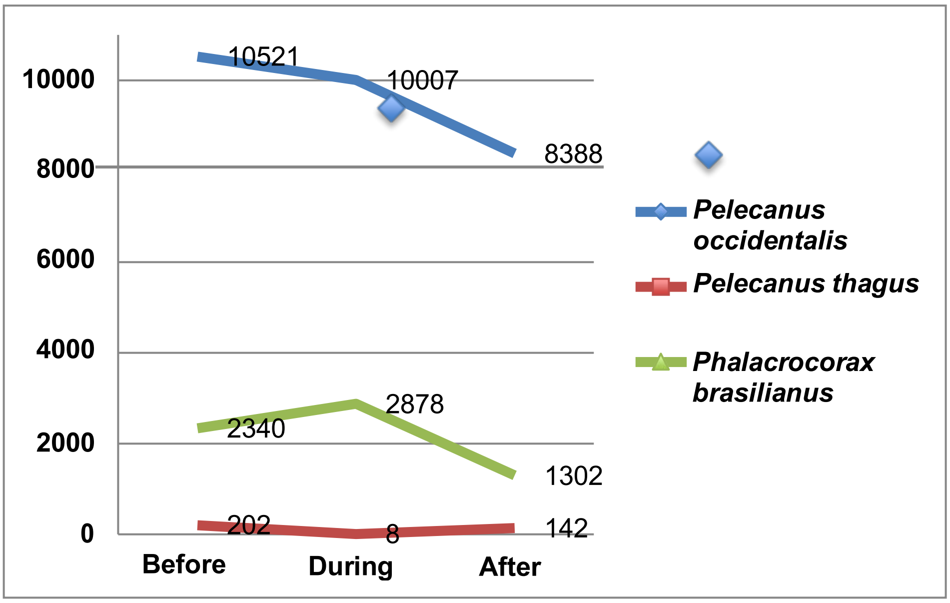
Table 14. Ecological Descriptors and Estimated Bird Density in the Study Sites in 2013. (Ecuambiente, 2013).

Site	Richness	Mean Abundance	H' in Average	1-D in Average	Average Density (ind/km^2)
Southwest Zone					
Cruce del Bravo	36	451	1.453	0.550	184.082
Estero La Calavera	29	1276	1.774	0.732	319.000
Bajo de Pongalillo	8	1274	0.396	0.252	25480.000
Isla del Amor	15	1178.33	0.605	0.288	78555.556
Faro de Jambelí	23	312	2.663	0.906	10400.000
Islet in front of Puerto Bolívar	19	3213.33	1.411	0.632	3213.333
Santa Clara Island					
Santa Clara Island and boulders	12	11635	1.207	0.659	50586.957
Bajo del Burro	8	689.50	1.096	0.591	55160.000
Northeast Zone					
Río Jubones	50	9429.67	1.636	0.700	628.644
La Puntilla	52	3503	2.101	0.799	700.600

Prepared by: Ecosambito, 2020

In that study, it was estimated that the 3 most abundant seabirds in the area were the Brown pelican (*Pelecanus occidentalis*), followed by the Peruvian pelican (*Pelecanus thagus*), and then by the neotropical cormorant (*Phalacrocorax brasilianus*).

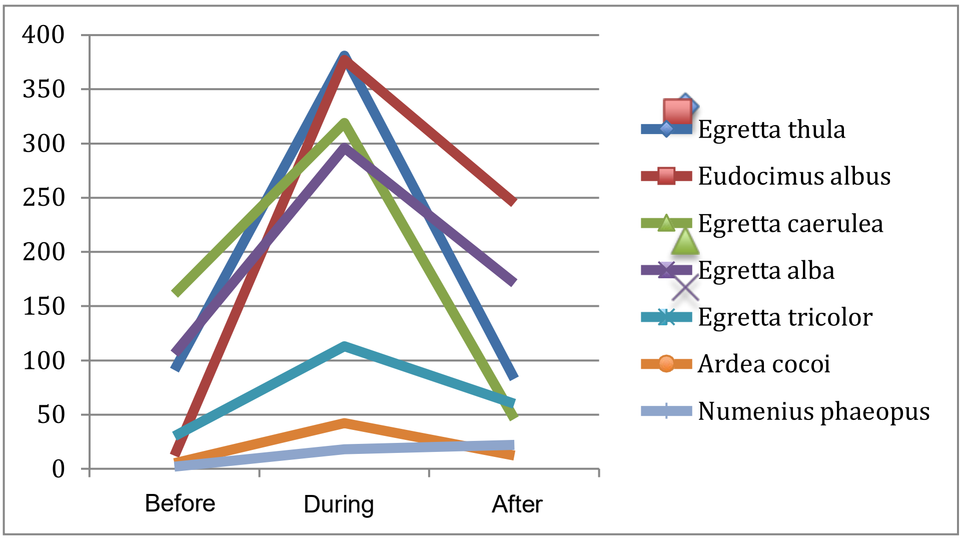
Figure 50. Populational Fluctuations of the 3 Most Abundant Seabirds in the Southwest Area (Jambelí Archipelago).



Prepared by: Ecosambito, 2020

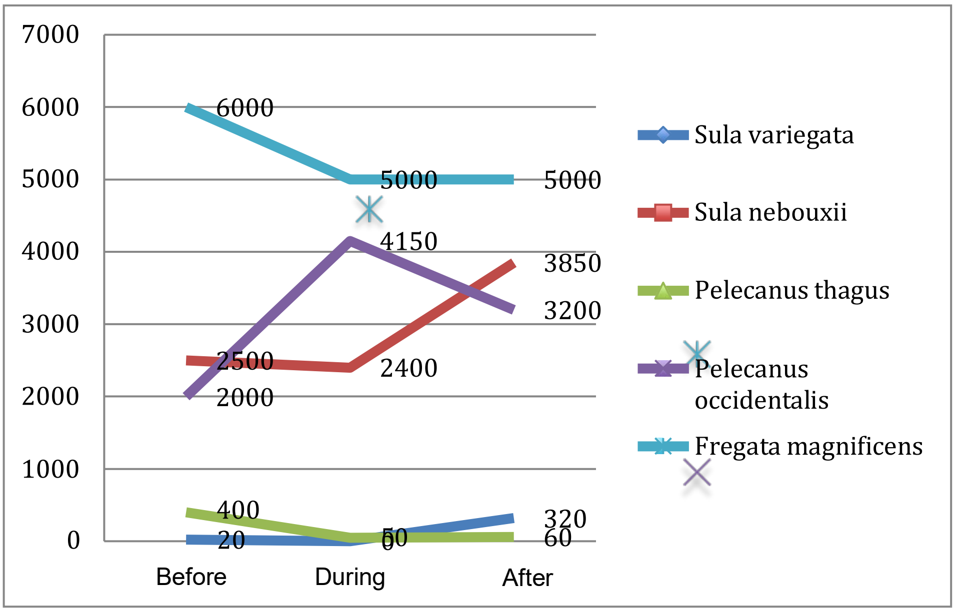
Figure 50 shows the fluctuations in the abundance of these species during the seismic data acquisition maneuvers of 2013, concluding that the pelicans were not affected by the sonic pulses and that their reduction is due to migratory processes, while the neotropical cormorants would have been affected by the subsea noise.

Figure 50: Populational Fluctuations of Wading Birds in the Jambelí Archipelago at Count Sites.



Prepared by: Ecosambito, 2020

Figure 51. Populational Fluctuations of the Most Abundant Birds in Santa Clara Island, Fourth Quarter of 2013.



Prepared by: Ecosambito, 2020

Although no bird censuses were conducted during the 2020 study period, it is evident that the same species in addition to Fregata magnificens and representatives of Laridae (gulls and terns), Sulidae (boobies), are the most abundant seabirds in environments associated with the high seas and mangroves of the Jambelí archipelago as well as wading birds both on beaches and mangroves.

Photographic Record 6. Brown pelicans and Peruvian pelicans, birds linked to artisanal fishermen, wait for fish discarded by fishermen and fishermen tolerate them; during the November 2020 observation activities, the rescue of a pelican that was entangled in a net by fishermen was observed.

Prepared by: Ecosambito, 2020

A study conducted in 2016 identified 50 common birds in the Jambelí archipelago (Orihuela - Torres et al, 2016). The first 10 birds identified were as follows:

1. *Fregata magnificens*, Frigatebird
2. *Sula nebouxii,* Blue-footed booby
3. *Phalacrocorax brasilianus,* Neotropical cormorant
4. *Pelecanus occidentalis,* Brown pelican
5. *Nycticorax nictycorax,* Black-crowned night heron
6. *Nyctanassa violacea,* Yellow-crowned night heron
7. *Boturides striata,* Striated heron
8. *Ardea cocoi,* Cocoi heron
9. *Ardea alba,* Great egret
10. *Egretta tricolor,* Tricolored heron.

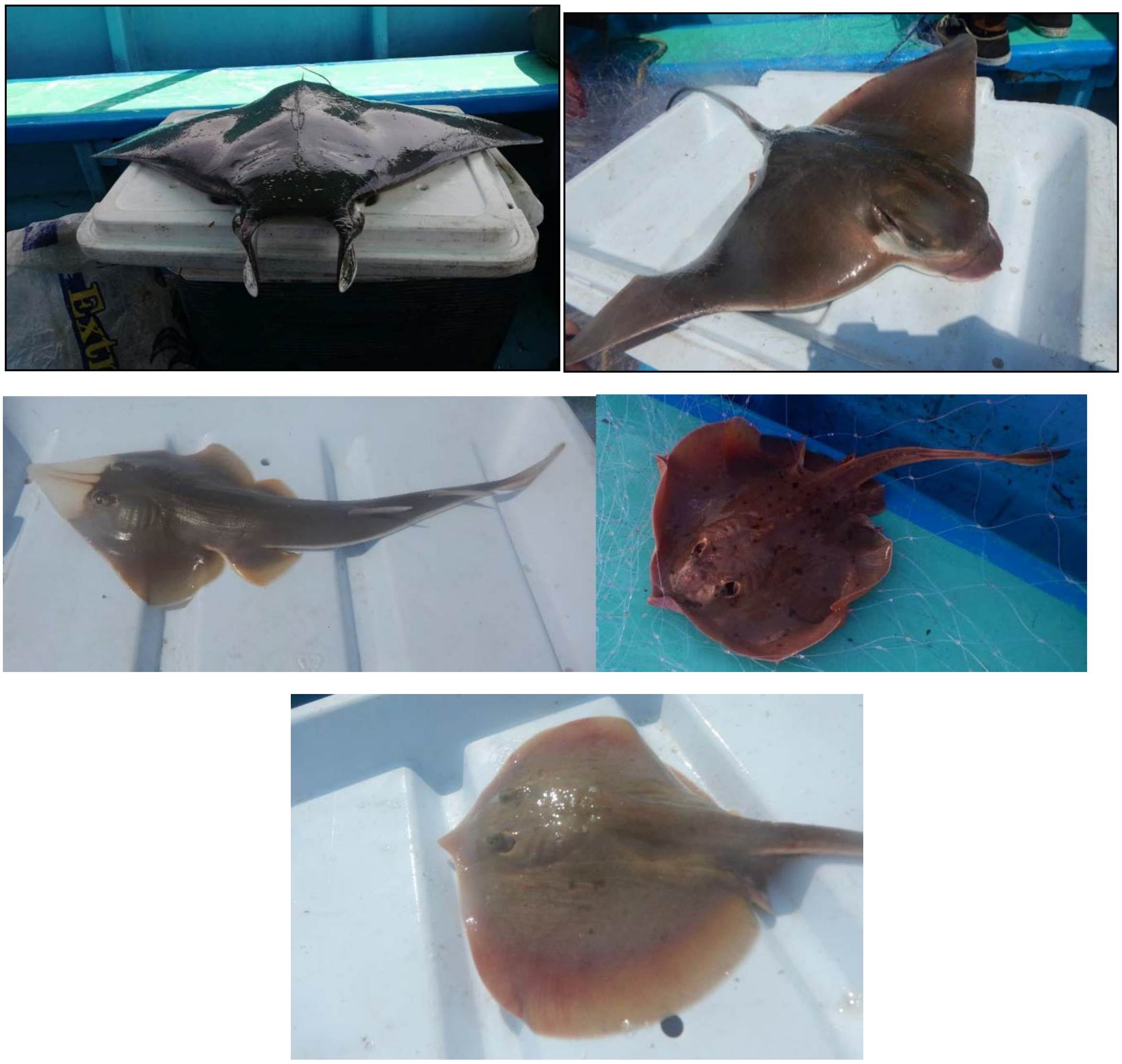
3.8 Protected Marine Fauna (Mammals, Reptiles and Cartilaginous Fishes)

Regarding records on the presence of protected marine life, during the 2018-2020 fishing monitoring, the release of at least 8 species of fish considered vulnerable in the IUCN redlist, which, although not listed as protected marine life in the Ecuadorian legislation, are included in international agreements for their protection, among which the following stand out:

- Guitar ray, *Rhinobatus leucorhynchus*

- Munk’s devil ray, *Mobula munkiana*
- Snouted eagle ray, *Myliobatis longirostris*
- Roger’s round ray, *Urotrygon rogersi*
- Hawaiian sting ray, *Dasyatis brevis*
- Seahorse *Hippocampus inges*
- Thorny rays (2 species) *Rostroraja equatorialis and Raja sp.*

Photographic Record 7. Protected species released during fishing monitoring, from top to bottom and from right to left: Munk’s devil ray, snouted eagle ray, guitar ray, Roger’s round ray and Hawaiian sting ray.



Prepared by: Ecosambito, 2020

Although there was no exclusive monitoring for marine mammals, during the biological monitoring conducted in the period 2018-2020 there were two interactions with marine mammals: Sea lions Otaria flavescens (LC) or species of low concern despite the fact that in Ecuador its population is reduced compared to populations in Peru and Chile, these inhabit rocky areas of Santa Clara Island and when fishing near the island twice nibbled fish caught in the net.

The second species with which we had interactions corresponded to 2 troops of striped dolphins, Stenella coeroleualba (LC) that were observed transiting inside the dredge deposit bucket heading northwest. Previous records of these oceanic dolphins report their presence in the area from September to January, with reports of troops exceeding a thousand individuals in the vicinity of Santa Clara Island, however in the two encounters with these dolphins, the first occasion was estimated at 120 animals and the second occasion between 70 and 80; On both occasions the presence of calves was observed and the initial approach of a patrol of larger adult males that scanned the boat confirming the absence of risk was notorious, however the bow ride behavior of playing with boats crossing and jumping in front of the boats was not noticeable and they were not looking for any interaction.

Photographic Record 8. Troops of striped dolphins (Stenella coeroleualba) crossing the Project's deposit basin for dredged material.

Prepared by: Ecosambito, 2020

The most emblematic protected being of the Ecuadorian coast and that is related to tourism interests is the Humpback Whale Megaptera novangliae (LC) that arrives from Antarctic waters to the coasts of Ecuador and southern Colombia in mid-May each year to hold courtship and copulation in a period where they practically do not feed, The date of courtship and their return to southern waters occurs in mid and late October, during the period 2019 was observed on two occasions but very far away a couple of specimens of this cetacean, however it is important to mention that they are hardly observed entering the Jambelí channel and the probability of encountering them in the dredge deposit bucket is minimal.

In fact, in the opinion of the author of this report, stopping dredging maneuvers on dates when this cetacean is present, even if it is a precautionary approach, is an exaggerated measure because these whales have been monitored for decades and their routes are well described: in the last decades using satellite monitoring it has been determined that whales would hardly enter the Jambelí channel because they require clear waters and most sightings of which there is even a tourist offer are associated with the visit to Santa Clara Island as shown in Figures 52 and 53 obtained from Felix and Guzman (2014) and Ecuambiente (2016).

Photographic Record 9. Green sea turtles (Chelonia mydas) found in the vicinity of Las Huacas (Courtesy of Guardianes del Mar) and dead adult floating between Bajo Alto and Playa Coco.

Prepared by: Ecosambito, 2020

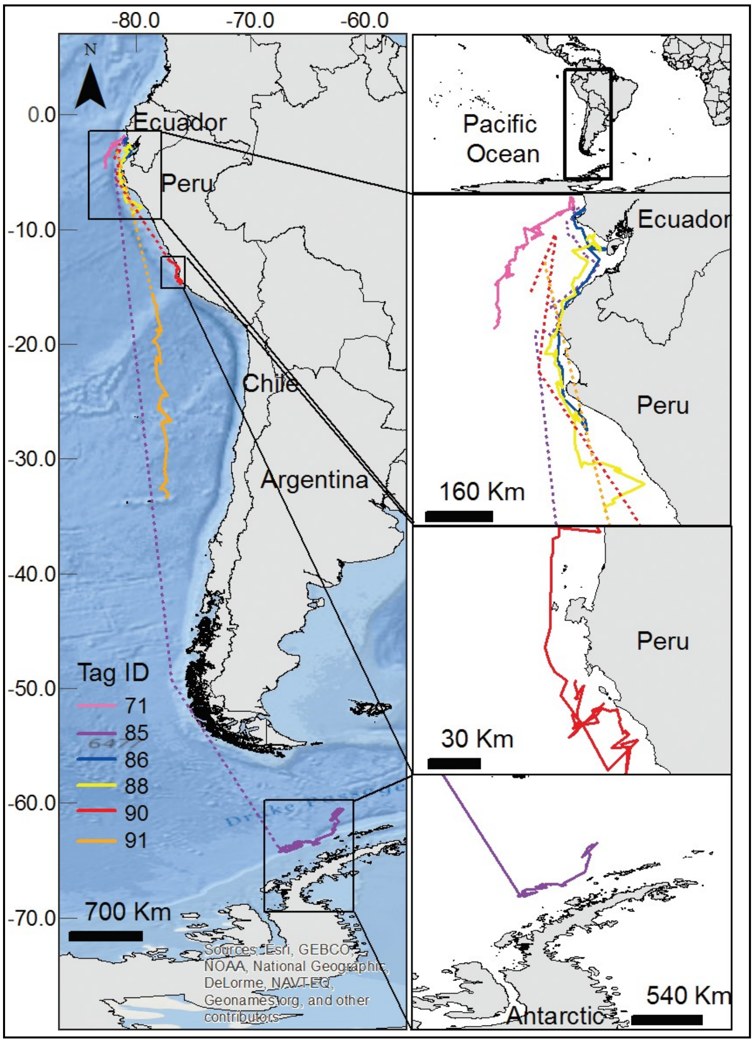
It is important to mention that all cetaceans are protected by Ecuadorian law as are all species of chelonians, having recorded only two encounters in the period 2018-2020 with green turtles Chelonia mydas species considered endangered according to IUCN Redlist and were observed in the navigation path to the dredging deposit bucket as well as on three occasions floating corpses were found in the vicinity of El Bravo and during November 2020 between Bajo Alto and Playa Coco.

Recent communications with "Guardians of the sea" which is a process of environmental education promoted by the Ecuadorian Navy with children of the Huacas in the archipelago of Jambelí, communicate that the beaches in the vicinity of the Huacas could possibly be a nesting area, because in the last weeks of November 2020 juveniles of this turtle have been found.

Other protected species recorded in the vicinity of Santa Clara Island are the whale shark Rhyncodon typus, which is commonly observed on the gas platforms of the Amistad field located to the south of Santa Clara Island, as well as the giant manta Mobula birostris, with the last report of reproductive aggregations in the Amistad field area in 2012.

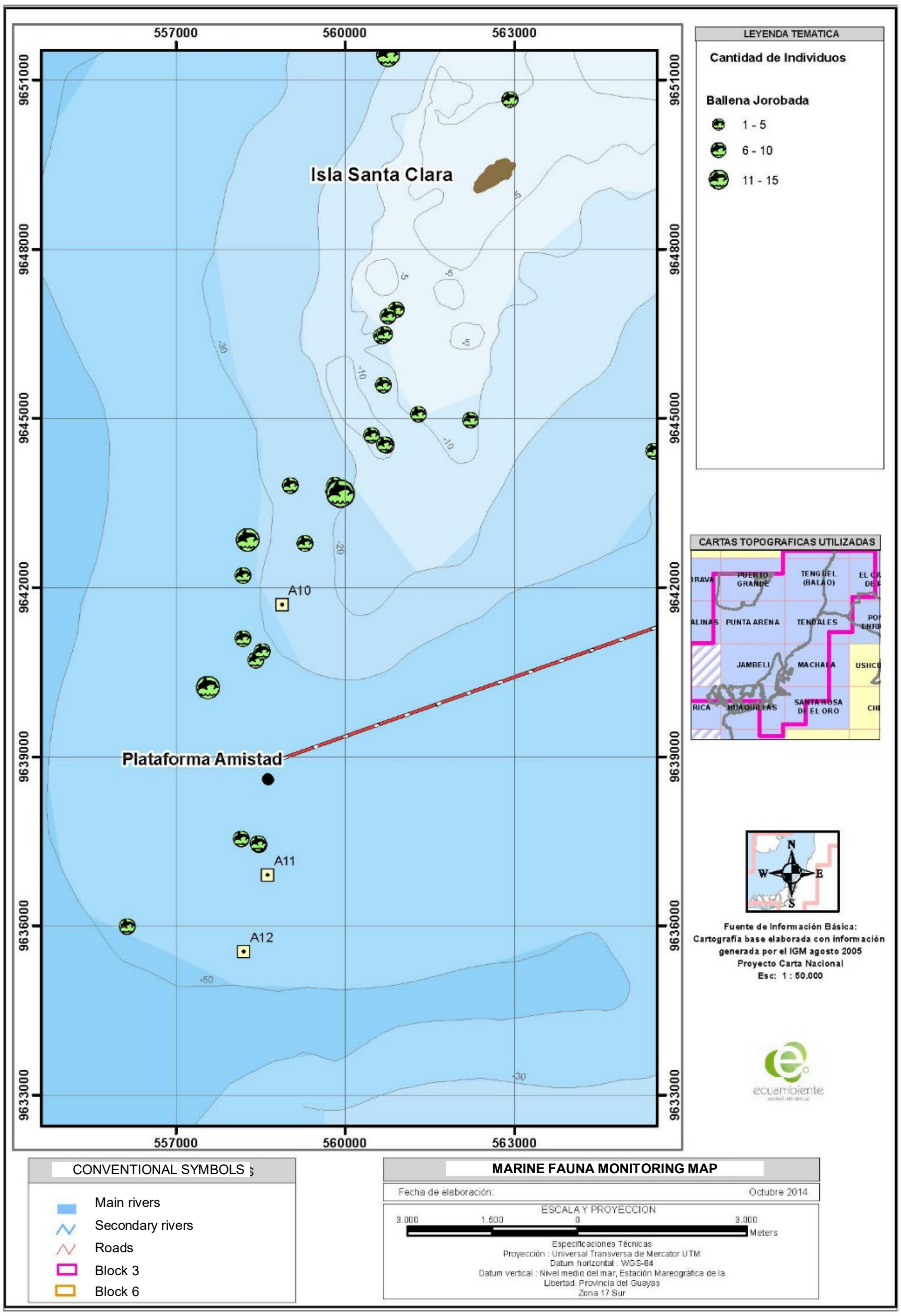
Finally, it is proposed to increase the monitoring of these creatures in the area of influence of the Puerto Bolivar project associated with the monitoring of underwater noise levels, and for this purpose the acquisition of a hydrophone should be managed.

Figure 52. Migration Routes of Megaptera Novangliae obtained through Satellite Monitoring (Felix y Guzman, 2014).



Prepared by: Ecosambito, 2020

Figure 53. Coordinates of Watching and Estimation of the Number of Humpback Whales (Megaptera novangliae) obtained through Visual Records in August 2014 (Ecuambiente, 2014).



Prepared by: Ecosambito, 2020

4. Comments

Table 14 contains a compilation of the marine species richness recorded during the fieldwork carried out in the current period and the monitoring activities undertaken in the 2018-2020 period. Even though several species were recorded under more than one category, given that, as established in the general considerations, the feasibility of quick quantitative samplings that are easy to replicate was proposed as categorization, it is evident that the planktonic creatures observed correspond, in their meroplanktonic fraction, to creatures subsequently described as benthos, infauna and nekton.

Table 15. Records of marine species collected and captured in the area of influence of the Puerto Bolívar project

Main Group	Phytoplankton	Zooplankton (>300 microns)	Zooplankton (>500 microns)	Benthic Community	Beach Infauna	Ichthyo-fauna
	Bacillariophyta 123 species	Crustacea 22 types	Crustacea 21 types	Crustacea 12 species	Crustacea 15 species	Pisces 72 species
	Myozoa 43 species	Chaetognata 3 types	Chaetognata 3 types	Scaphopoda 1 species	Bivalvia 23 species	
	Protozoa 14 species	Polychaeta 7 types	Polychaeta 6 types	Bivalvia 18 species	Gastropoda 7 species	
	Cyanophyta 10 species	Larvacea 1 type	Larvacea 1 type	Gastropoda 12 species	Echinodermata 4 species	
	Charophyta 1 species	Urochordata 4 types	Urochordata 3 types	Echinodermata 3 species	Polychaeta 12 species	
		Cnidaria 5 types	Ctenophora 1 type	Cnidaria 1 species	Cnidaria 1 species	
		Mollusca 3 types	Cnidaria 6 types	Nemertea 1 species	Brachiopoda 1 species	
		Echinodermata 1 type	Mollusca 3 types	Polychaeta 28 species	Platyhelminthes 1 species	
		Pisces 8 types	Echinodermata 3 types	Sipunculida 1 species	Nemertea 1 species	
			Pisces 12 types	Priapulida 1 species	Sipunculida 1 species	
				Platyhelminthes 1 species		
Sub-total	191	54	59	79	66	72

Prepared by: Ecosambito, 2020

Regardless of the accuracy in filtering richness and diversity data in this compilation, it should be kept in mind that diversity studies are not always compatible with the needs of a project, because to achieve an adequate knowledge of the biodiversity of an area requires years of monitoring and training of the observer team in new methods for the study of marine life.

Thus, when contrasting the data in this report against bibliographic sources, it would seem that the results achieved are very poor, but in reality they are not and reflect a great wealth of life forms coexisting in habitats that are not very diverse due to the scarce differences in depth and the scarcity of hard bottoms in the Jambelí Channel and Archipelago as well as in inland waters. In this sector outside of Santa Clara Island, all the hard bottoms are artificial, except for small "pebbles", which are the result of very exceptional catches, such as the fact that 2 seahorses were caught in the Santa Rosa estuary in front of the Puerto Bolivar facilities but in an entrance towards Jambelí, a situation that shows small "mini reefs" in this estuary, as well as the unique catch of the Damselfish, *Mulatillo* or *Ronco Peña* as it is called by local fishermen, referring to the species *Stegastes acapulcoensis*, which is typical of reefs.

In this way, we found that the extinct National Fisheries Institute (INP) estimated in 2017 a richness of 13 species of chondrichthyans or cartilaginous fish and 153 species of actinopterygians for the province of El Oro, totaling 166 species (Herrera et al, 2017), which were recorded through years of observation of landed catches obtained with different fishing gear at 21 sites in the province of El Oro, in addition to observation by diving and conducting tours in internal areas; against only 48 catches of 30 minutes with 3.5" nets in 4 sites plus two catches with 2 ¾" nets and 70 casts of cast nets that revealed 81 different fish, almost half of the species estimated for El Oro.

Photographic Record 10. "Duron", fish of the Gobidae family, collected on the muddy beaches of Pongal and Hippocampus ingens or "seahorse" collected with a cast net at the southern entrance of the AUSCEM "Vikingos del mar" in Jambelí. less than 2 km from Puerto Bolivar project.

Prepared by: Ecosambito, 2020

Regarding marine invertebrates, Maria Jose Brito and Elba Mora Sanchez, from the former INP, published in 2017 the book "Moluscos marinos distribuidos en la primera milla de la costa ecuatoriana" (Marine mollusks distributed in the first mile of the Ecuadorian coast), where 66 species of mollusks were identified through manual collection assisted by shell fishermen or collectors from the study site, while in the present study 66 species of marine invertebrates were recorded from the beach infauna, 30 of which were mollusks that were collected in 5 different sites, specifically at Playa Isla del Amor it is noted that abundance of buried life forms, with36 marine life forms identified, 20 of which were mollusks.

This result is achieved in a morning of work in 8 analysis stations that are close to the results obtained by Narvaez et al (2019), who recorded 27 mollusks in Isla del Amor after placing 9 stations (each with 3 replicates in 3 strata–low, medium and high–with respect to the intertidal width, i.e. with 9 1-m2 quadrats) distributed throughout the island; these were checked on a monthly basis from May to October 2016.

Regarding the vulnerability of the marine life studied and the presence of endangered species in this study, according to the IUCN Red List database, only 8 fish are in the vulnerable category and were immediately released in good condition, as well as cephalopods that were incidentally collected with nets; in the rest of the zoological groups analyzed, basically all the animals described correspond to species not considered in this database because it focuses mainly on higher vertebrates. Of the protected marine creatures, the one that should be taken more carefully and even strengthen local conservation initiatives corresponds to the green turtle Chelonia mydas, the only endangered species observed in this study.

The records achieved in this report are considered adequate with respect to the sampling effort and provide a methodology that is easy to replicate allowing for an adequate statistical temporal contrasting as long as sampling units are distributed proportionally to the different sectors to be monitored.

5. Bibliography

Margo Branch (2001). Coastal and Marine Life: general classification. Classification of Marine Species. The Coastal Management Office, Marine and Coastal Management, Department of Environmental Affairs and Tourism.

Fernando Felix and Hector M. Guzman (2014). Satellite Tracking and Sighting Data Analyses of Southeast Pacific Humpback Whales (*Megaptera novangliae*): Is the migratory Route Coastal or Oceanic? Aquatic mammals 40 (4), 329-340. Doi: 10.1578/AM.40.4.2014.329

Rebolledo Monsalve (2014). Monitoreo de fauna sensible asociada a la fase de perforacion del campo Amistad desarrollada por petroamazonas en el Bloque 6, Periodo Agosto-octubre 2014. Ecuambiente Consulting Group.

Francisco Sornoza (2013). Estudio de fluctuaciones de poblaciones de aves marinas del Bloque 3j asociada a la segunda fase de adquisicion sismica 2d de ENAP SIPEC. Ecuambiente Consulting Group

Wohlers, J., A. Engel, E. Zollner, P. Breithaupt, K. Jurgens, H. G. Hoppe, U. Sommer, and U. Riebesell (2009), Changes in biogenic carbon flow in response to sea surface warming, *Proc. Natl. Acad. Sci. U. S. A.*, **106**(17), 7067–7072, doi:10.1073/pnas.0812743106.

IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-3. https://www.iucnredlist.org.

ENVIRONMENTAL AND SOCIAL ASSESSMENT, PUERTO BOLÍVAR PROJECT – PHASE 1

– ASSESSMENT OF ECOSYSTEM SERVICES –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Table of Contents

Index of Tables

EXECUTIVE SUMMARY

The Puerto Bolívar Project, like most port projects, is located in a sector where some economic activities converge depending on the proper functioning of the different habitats making up the coastal marine ecosystem. This ecosystem provides multiple environmental services where the provision of goods – particularly in relation to fishing – is its most self-defining environmental service because, in the Ecuadorian jurisdiction, fishing resources are public access resources, whose trade supports the economy of thousands of families.

The Puerto Bolívar Port Terminal Project, managed by Yilport Terminal Operations (YILPORTECU) S.A., is located in one of the most productive environments of coastal marine ecosystems: estuaries with mangroves, forests adapted to exist at the land-sea interface which are scarce worldwide. These ecosystems are of great ecological importance since, in addition to providing goods through specific fishing activities, they provide other regulatory and environmental support services, drawing more and more attention to their conservation, and in Ecuador these ecosystems are protected.

This report briefly characterizes the main fishing activities developed in the area of direct influence and buffer zone of the Puerto Bolívar Project, starting from the description of modes and means required to be developed, and then describing fishing variables obtained from the record of catches stated by members of the association of artisanal fishermen "San Antonio" of Puerto Bolívar, whose productive descriptions were compared with data collected in the project area of influence using the same methodology at similar dates in 2013 to check for year-to-year differences.

Subsequently, the main environmental services will be discussed, emphasizing the sectors with mangroves close to the port facilities of Puerto Bolívar.

1. Introduction

Environmental or ecosystem services include those goods and services of common benefit that represent global benefits that can transcend a territory. According to UNEP[1], UNDP[2], FAO, IUCN and CGIA in the "Millennium Ecosystem Assessment" carried out in 2002, environmental services are grouped into 4 main categories such as the provision of goods, regulation services, cultural services, and support services.

Table 1 lists the environmental services identified in the project area of influence, as well as the descriptions suggested for assessment.

Table 1. Ecosystem services identified in the project area of influence

Category	Definition	Identified goods or services	Suggested indicators and means of verification
1.- Provision of goods	Direct use goods generated in a certain area	Fishing activities in the area of influence, Exploited fishing resources.	Fishing statistics, seasonal comparison with fishing production in the project area of influence
2.- Regulation of environmental quality	Climate regulation services, water purification, erosion control, flood control, etc.	Role of mangroves as barriers against marine erosion and adverse climatic events, functioning of mangroves as biofilters.	Multi-year comparison of mangrove cover in the area of influence. Sediment quality sector comparison
3.- Cultural services	Non-material benefits that enrich the quality of life, such as cultural diversity, recreation, religious and spiritual values, scientific knowledge, traditions.	Tourist activities, local scientific production	Number of tourists and visitors and average daily expenditure according to scientific publications
4.- Support	Services required to produce other services, such as primary production, soil formation, oxygen generation, flow of energy through food chains and biodiversity	Sediment retention by mangroves and mangrove accretion for colonization of more species Primary productivity as a source of energy for the development of food chains. Biodiversity, genetic reserves	Time evolution of Phytoplankton abundance using standardized methods of international use. Descriptive of ecological diversity

2. Methodology

2.1 Provision of goods: Description of fishing activities in the Project area of influence.

The description of fishing activities in the project area of influence is carried out in accordance with the following steps:

---

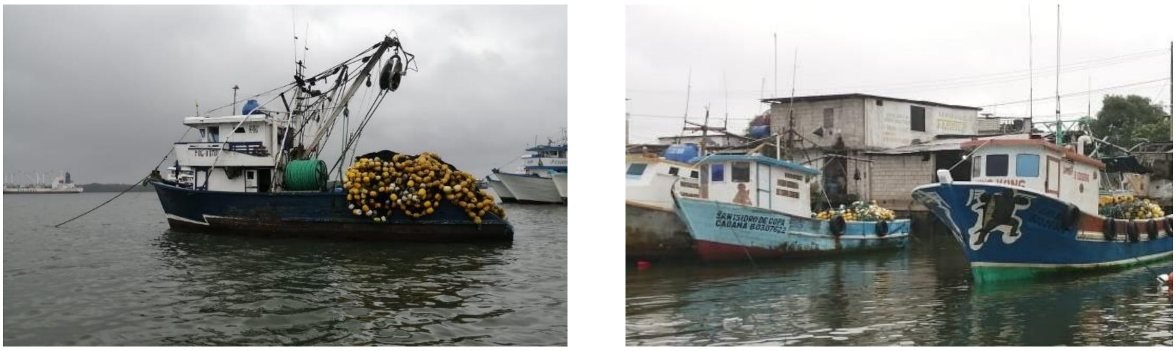
[1] United nations environment program, www.unep.org

[2] United nations development program, www.undp.org

a) **Estimate of seafarers in the project sector of influence.** For this purpose, the hypothesis considering the maximum on-board crew was used, that is, the number of crew members the fishing fleet would have, after accounting for vessels classified by type on Sunday, November 1 of the current year.

Photograph 1. Boats.- they do not have compartments to preserve fish. 'Fibras'.- Small fiberglass boats with cellar-type compartments.

Photograph 2. Industrial fishing boats



b) **Observation trips for fishing operations in open sea and inland waters:** The main fishing grounds near Puerto Bolívar were accessed, and fishermen were interviewed during their fishing tasks about the gear and fishing methods they used, in addition to reviewing their catches.

Photograph 3. Fishermen during fishing operations

c) **Productive monitoring or fishing statistics:** During November 2020, monitoring of fishing production or catch of 10 vessels was arranged with the association of artisanal fishermen "San Antonio" of Puerto Bolívar, through a fishing record sheet for each fishing trip, and it was expected to have 250 record sheets under the assumption that the vessels would make 25 trips in the best scenario. A fishing record sheet sample is shown in Annex 1, and variables are extracted from this sheet and entered into calculation templates such as Catch composition and value of first-sale of resources captured, Catch (Total biomass and biomass for each resource captured, expressed in lb/fishing trip, duration of tasks or time out of port, effective fishing time (working time of gears used) estimated in hours; CPUE[3] (total biomass or biomass of a specific resource divided by the estimated effective fishing time in lb/fishing hour, expenses incurred or investment in fishing trips (US$/fishing trip), and the profit per trip (US$/vessel/fishing trip).

When estimating catch statistics using different fishing gear, as well as estimating the artisanal fishing fleet, it is feasible to make assumptions to help value fishing production in the area of influence. These data allow us to measure the value of local fishing productivity.

d) **Statistical comparison of local fish production:** The fishing statistics obtained during November 2020 were compared with fishing statistics collected with the same

[3] Catch per unit of effort

methodology in November 2013, when the artisanal fishing productivity was recorded during the 2D seismic data collection in block 3J Jambelí.

2.2 Environmental regulation services and support services: Description of mangroves in the project area of influence.

The description of services provided by mangroves and associated water bodies included a review of relevant bibliographic background, as well as studies focused on the local conditions of mangroves in the area of influence of the Puerto Bolívar Project. Both services (regulation and support) are focused simultaneously when referring to a particular ecosystem that combines both services in common processes.

2.3 Cultural services.

Tourism. - There are communities and social groups that benefit from tourism through the scenic resources of the Santa Rosa channel and the Jambelí archipelago.

The Malecón de Puerto Bolívar is a traditional recreation area for the citizens of Machala, who visit it, both for its scenic quality and for its gastronomy.

Jambelí beach and El Faro are widely visited throughout the year, both by locals and foreigners, particularly by the inhabitants of the southern highlands of the country.

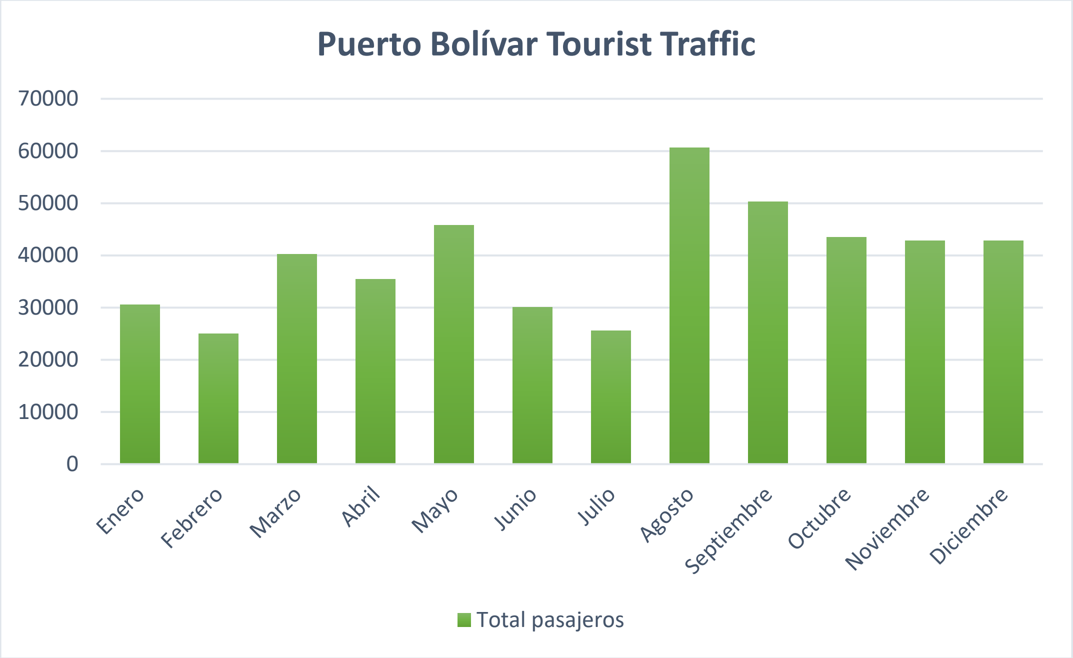
Sea transport. People that inhabit and sustain themselves from the ecosystem of the Project area depend on sea water and estuaries to be able to transport themselves and develop their supply activities, sale of products, and trade with mainland population, in general. On the other hand, in the Puerto Bolívar Cabotage Pier, there are two tourist transport cooperatives: Cooperativa 31 de Julio and Cooperativa "Rafael Morán Valverde", each one has 15 registered vessels.

These 30 vessels, with capacity for 43 passengers each, carry out the passenger transport to Jambelí Island, taking approximately 40 minutes. The tours take place throughout the morning, from the Puerto Bolívar cabotage pier to Jambelí Island. In the afternoon, from 3 PM, the tours get back to Puerto Bolívar.

The data on the frequency of trips, provided by Betty Sánchez, Manager of the Rafael Morán Valverde Cooperative, in an interview on November 2, 2020, are shown in Table 2.

Photograph 4. Upper: Tourist transport to Jambelí Island. Lower: Jambelí Beach (El Telégrafo, 2020)

Table 2. Total passengers transported to Jambelí Island, yearly estimation.



January, February, March, April, May, June, July, August, September, October, November, December, Total passengers

Research.- scientific research is a cultural service that is still underused. However, there are more and more institutions, particularly NGOs, that promote research in mangroves, dry forests, sea and estuaries. The most active ones include: Fundación Heifer, Conservación Internacional, Cooperación Alemana, GIZ, Universidad Particular de Loja.

3. Results

3.1 Provision of goods. Fishing activities in the project area of influence

3.1.1 Modes and means for fishing activities observed in the project area of influence

The main modes of fishing activities in the province of El Oro and in the Project area of influence are summarized in Table 2 where the means required for fishing are described. Although not all modes are used for fishing in the area of direct influence, all of them are operationally related to the project area of influence or Puerto Bolívar from where most of the vessels dedicated to fishing set sail.

Table 3. Modes and means of fishing in the area of influence

MODE	Means and characteristics
PAP - Pedestrian artisanal fishing	***Intertidal harvesters*** (seafood gatherer).- shellfish, clams, mussels, oysters and red crabs.
PAF - Fishing with passive or fixed gear	***Intertidal nets, Bottom-set gill nets, Fish weir, Fyke nets***, focused on the capture of pelagic and coastal demersal fish, crustaceans and mollusks.
PAC - Non-motorized coastal artisanal fishing	***Wooden/fiberglass 'bongo' boats***, 3-5 m in length, 1-2 fishermen/bongo, used for shrimp, demersal, coastal pelagic, estuarine fish.
PACM - Motorized coastal artisanal fishing	***7.5-9 m, 40/75 Hp Fiberglass boats***, 2-3 fishermen/boat, used for shrimp, demersal, coastal pelagic, large fish
PAA - Artisanal open-sea fishing	***7.5-9.5 m fiberglass boats with 1-2 75-Hp engines***, 3 fishermen/boat, used for coastal pelagic, oceanic pelagic fish in the vicinity of Santa Clara Island.
PI - Industrial fishing	***Vessels of up to 18m***, 6-9 crew members, seine nets or "boliches", catch carried out outside of 8 nautical miles from the coastline
AQUACULTURE*[4]	996 shrimp farms totaling 41,637 hectares in the province of El Oro in 2018; 652 farms (20,886 ha) operating in beach and bay areas and 344 farms (20,751 ha) operating in highlands.

Pedestrian artisanal fishing, PAP. This fishing mode exclusively requires the displacement and physical work of a person who uses resistant clothing to move in intertidal sectors such as mangroves and muddy beaches, plus the use of hooks if the fishermen focus on the catch of red crabs *Ucides occidentalis*.

It is difficult to estimate the number of people dedicated to this activity, since their number is variable and will fluctuate depending on the need for local consumption (livelihood) and the commercial demand for exploited resources that will be sold, with "pulses" of resource

[4] Although aquaculture is not an extractive activity, its resources compete with fishing products in the market. There are few artisanal producers in the project area of direct influence, and thus it is mainly an industrial activity.

exploitation with less economic interest, while resources with higher prices have a more continuous exploitation.

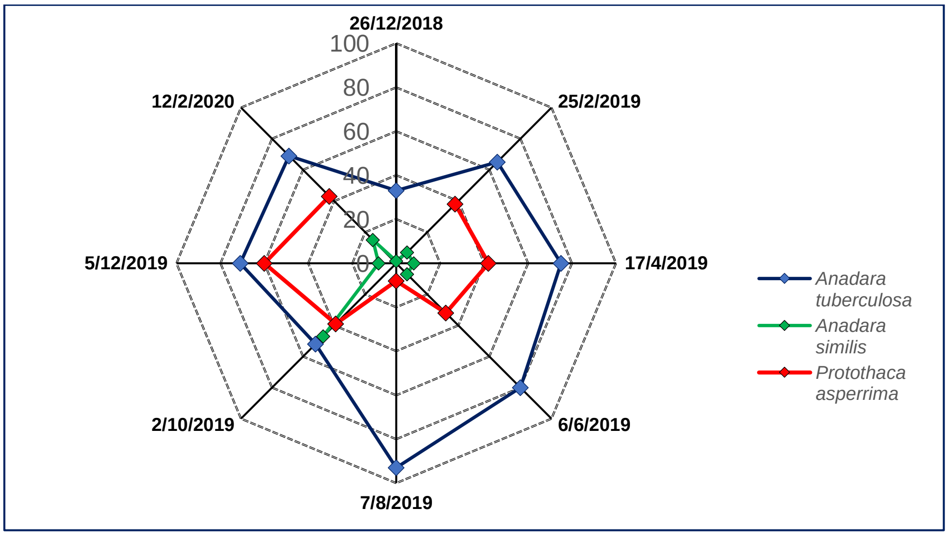
This activity takes place in 3 different habitats, i.e. mangroves, intertidal beaches and rocky shores. The mangroves near the Terminal are granted in concession to associations of fishermen and tourist entrepreneurs, and their members have the exclusive right to catch black shells *Anadara tuberculosa*, *Anadara similis*, mussels *Mytella guyanensis*, swamp clams *Protothaca asperrima* and red crabs *Ucides occidentalis*. However, in practice, these sectors do not have permanent security and are continuously exploited by gatherers not belonging to the associations, thus resulting in conflicts between custodial fishermen and transgressive gatherers.

Shellfish gathering in mangroves close to the Project is variable, and both *A. tuberculosa* and *A. similis* have a permanent ban for minimum extraction size established at 45 mm of valve width (Ministerial Agreement No. 005 of August 2, 2005). The average catch of a shellfish gatherer in a 4-5 hour work task is estimated at 300 shellfish, with great variability per sector. Young gatherers with greater displacement speed manage to catch over 500 shellfish and exceptionally they can reach 1000 units per day.

Photograph 5. Alexis claims to gather from 500 to 1000 shellfish per shift in mangroves "where there are shellfish" near Puerto Bolívar. He was put to the test on November 5, 2020, and managed to gather 155 shellfish in one hour.

In the 2018-2020 period, 8 bivalve abundance samplings were carried out with individual gathering of 1 hour at the AUSCEM (Sustainable Use and Custody Agreement of Mangrove Forests) “Vikingos del Mar” on the east margin of Jambelí Island, particularly in mangroves at the entrance arm to said town from the Santa Rosa estuary. An average gathering included 67 “female” shellfish *Anadara tuberculosa*, 13 “male” shellfish *Anadara similis*, 44 mussels *Mytella guyanensis*, 37 white clams *Protothaca asperrima*, 4 shellfish *Anadara grandis* and 5 striped clams *Chione subrugosa* in one hour. When considering the total of individuals gathered independently of the species, the mean bivalve abundance in this sector of mangroves amounted to 148 ± 49 individuals in one hour. The fluctuation of abundance of collected resources present in the 8 monitoring samplings carried out at the AUCEM "Vikingos del Mar" is observed in Figure 1.

Figure 1. Fluctuation of commercial bivalve abundance in the 2018-2020 period at the AUSCEM "Vikingos del Mar"



Photograph 6. Anadara tuberculosa and Mytella guyanensis

Photograph 7. Anadara similis and Anadara grandis

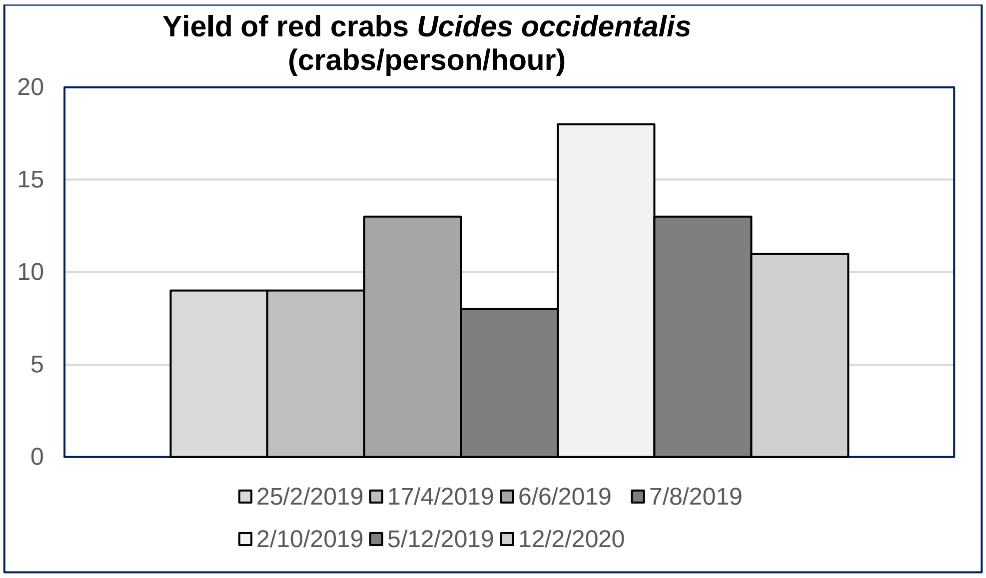
At the AUSCEM “Vikingos del Mar”, red crabs *Ucides occidentalis* are also gathered. An experienced crabber can obtain from 1 to 1.5 “plates” (a plate = 48 crabs) of crabs in a workday of 4-6 hours, and in periods of greater abundance, an experienced crabber could reach 2 "plates". In the 2019-2020 period, the productivity of crabs at the “Vikingos del Mar” area was tested, always using the same crabber that had an average catch of 11.57 ± 3.45 crabs per hour. (Figure 2).

The red crab resource is regulated with a minimum extraction size of 7.5 cm in cephalothoracic width and two temporary extraction bans associated with reproductive events of this species from February 15 to March 15 and from August 15 to September 15 of each year as decreed and regulated by Ministerial Agreement No. MPCEIP-SRP-2020-0013-A, of January 17, 2020.

Photograph 8. Red crabs Ucides occidentalis

Photograph 9. Crabber. Please note the hook used to remove crabs from their caves

Figure 2. Crab yield in mangroves of the AUSCEM "Vikingos del Mar"



During the current COVID 19 pandemics, the price of this resource, like most fishing resources, fell dramatically to US$ 15 for a plate of crabs, a price that would be paid for a dozen crabs under normal circumstances.

This situation illustrates the dependence of these resources on the tourist activity of the Machala-Puerto Bolívar conurbation, where the resources gathered in mangroves are used in multiple dishes offered in local restaurants.

The mangrove concessions, or AUSCEM[5], are restricted to emerged forests and do not include water bodies and intertidal sectors as such, thus there are 2 sites of the Santa Rosa estuary located to the north of the port facilities of the Puerto Bolívar Port Terminal with low slope beaches and muddy and mixed bottoms with open public access where two clam types are mainly gathered, i.e. the striped clam *Chione subrugosa* and the swamp clam or white clam *Protothaca asperrima* in addition to scarce shellfish *Anadara grandis* and mussel *Mytella guyanensis* and other bivalves of no commercial interest.

Photograph 10. Striped clam Chione subrugosa and white clam Protothaca asperrima

In these beaches, individuals and family groups from Puerto Bolívar can achieve gatherings with variable yields depending on sex, age, physical condition, and the expertise of a gatherer. This situation was observed in the bimonthly monitoring of 2019-2020 on the beach near the AUSCEM “Isla del Amor”, the closest to the Puerto Bolívar Port Terminal. In December 2018, a 27-year-old young man filled a 20-liter bucket with 1432 individuals of 8 different bivalve species in one hour, while in February 2019 in exactly the same place, a woman of almost 50 years old gathered 303 individuals of 4 different species in the same period of time.

[5] Sustainable Use and Custody Agreement of Mangroves

Photograph 11. Clam gatherers on Isla del Amor beach and clam tradable unit

As mentioned above, not all the bivalve individuals collected from beaches and mangroves are proper for trading. Shellfish, mussels and two types of clams are in demand in Puerto Bolívar, and the most precious resource is the black shellfish *Anadara tuberculosa*, which would cost, on dates of greatest demand, about US$ 15 under normal circumstances, while mussels are sold from US$ 1.5 to US$ 2 per 100 individuals, and striped and white clams are sold from US$ 3 and US$ 5 per a 20-liter bucket that can contain from 1400 to 1900 individuals depending on its average size.

White and striped clams lack a minimum size for regulated extraction and are exploited mainly by lower-income family groups, and dozens of restaurants take advantage of this situation and use these clams to increase the profitability of dishes that include various seafood, increasing the proportion of these clams in dishes called “pailas marinas”, “maremotos”, “festines de mariscos”, etc., which would hardly have more than 8 black shellfish per serving but can contain dozens of clams called “machaleras”, a local name for striped clams.

The pedestrian extraction of oysters is restricted to the artificial breakwaters of the Jambelí beach resort, made up of 5 rockfill structures where an encrusting benthic community has developed and includes rock oysters *Stiostrea prismatic* that are exploited by fishermen from that beach resort and their soft parts are sold at US$ 10 per 1-liter plastic container. Please note that this resource does not present continuous gathering and would have a specific demand since the oysters that develop in the intertidal zone are quickly harvested, but not its subtidal fraction, which is exploited by diving.

Photograph 12. Stiostrea prismatic oysters in artificial stonework or breakwaters at the Jambelí beach resort

Fishing with passive or fixed gear, PAF.- This type of fishing includes the so-called "caleteras" (bottom-set gill nets) or "tapes" (fish weirs), which are located in intertidal spaces, where an extensive row of wooden posts fixed on soft bottoms is installed to tie nets made of unknotted polyester multifilament or black Rachel multi-filaments with mesh diameters of 1", or black twisted thread nets called "camaroneras" (shrimp catchers), with mesh sizes from 1¼" to 2".

These nets may exceed 1 kilometer in length and are tied to the base of the posts used, remaining extended over the bottom during low tide and are tied to the top of the posts to form a screen during high tide. Therefore, these nets work during high tide and once the tide begins to drop, multiple fish, crustaceans and mollusks that entered the mangrove edges are trapped. Then the nets are checked, and seafood is collected manually at the next low tide.

Please note that this fishing method is questioned and is considered harmful since it lacks selectivity and employs a maximum of 3 people. That is the reason why it is banned by Ministerial Agreement No. 134 of May 24, 2007, which allows its use exclusively on Puná Island, as cited:

"Article 4.- In the bioaquatic species reproduction reserve zone (one mile) for the exclusive case of Puná, the use of "caleteras" (bottom-set gill nets) is allowed subject to the following considerations:
a) A lower section with a height not exceeding 0.80 m of PA multifilament, with an effective mesh size not less than 38 mm (1' ½").

b) An upper section with complementary height at the maximum high tide, with an effective mesh size of not less than 63 mm (2' ½").

The owners of the bottom-set gill nets shall request their respective authorization from the General Directorate of Fishing within 60 days of the issuance of this Agreement. Those who do not obtain authorization within the aforementioned period will not be able to fish with said nets which will be confiscated and destroyed. The General Directorate of Fishing shall carry out the respective controls of the technical characteristics of the nets based on the results and recommendations of the study carried out by the INP for this type of nets in Puná."

The same agreement sets out: *“Obstruction of estuaries, mouths of estuaries or rivers is prohibited, in accordance with the provisions of Article 5 of Ministerial Agreement 03317 published in Official Gazette No. 141 of August 6, 2003.”*

Despite this prohibition, two extensive bottom-set gill nets were observed on the inner margin of the Jambelí island towards the north of the Santa Rosa estuary, which are shown in Photograph 13.

Photograph 13. Bottom-set gill net identified in the Santa Rosa estuary. Please note the port complex Puerto Bolívar Project to the left in the upper photograph.

Fyke nets.- Passive nets that emulate a shrimp trawl, but their wings, instead of being dragged by “arms” of shrimp boats, are tied to a “V-shaped” row of posts at whose vertex (both rows do not meet) a cylindrical funnel-shaped net is fixed. The net small opening remains open and is closed for a period of 1 or two hours during the period of greatest intensity of tidal currents, so a type of bag is formed when water level is falling (“vaciante”, or falling tide net) or rising (“creciente”, or rising tide net). Multiple seafood species dragged by local currents get trapped, and the main objective is 3 species of shrimp, i.e. *Protrachipene precipua* or pomade shrimp, *Penaeus vannamei* or white shrimp, and *Trachypenaeus byrdi* or zebra shrimp, in addition to fish. However, mainly in the capture of fish, this art, like the bottom-set gill nets, affects small juvenile fish because of its low selectivity, and therefore a high rate of bycatch and fishing discards occurs.

For these reasons, this practice has been highly questioned and is currently under the regularization process by Agreement No. MPCEIP-SRP-2020-0077-A of July 8, 2020, which establishes a period of 2 years to regularize its operation.

In the Project area of influence, the only fyke nets observed were located in two sectors of La Puntilla in the north end of the area of influence and in the vicinity of Bajo Alto, which is located far to the north of the project. Although fyke nets could not be counted efficiently because there was a low tide and the risk of being stranded because local fishermen install specific demarcations to access certain sectors of the coast. After conversations with local fishermen, this type of fishing method is said to need two people, but they work exclusively during spring tide (‘aguaje’), and the number of workers may increase when the catch is good. A good catch is considered 5 containers of shrimp and fish (around 350 lb).

Photograph 14. Left: fyke nets for shrimp and fish, in the vicinity of Bajo Alto. Right: the highest concentration of this gear in the La Puntilla sector

Non-motorized coastal artisanal fishing, PAC.- Fishing with drift nets or hooks mounted on hand lines, which are used on fragile boats called “bongo” where bow and stern are not differentiated and are manually propelled using oars or by wind when using “crab” nets. On November 1, 14 “bongo” boats tied to smaller boats from Huaylá estuary were counted. These smaller boats would mainly be used to transport people to boats.

This mode of fishing is in clear decline. During the first week of November 2020, only 3 fishing bongo boats were observed to the south of the Santa Rosa estuary, in a small fishing cove on the inner margin of Pongal island, named after the estuary that flows into this sector called “Guajabal”. 2 houses and 8 boats were observed, 3 of which were bongo boats that would be used to catch large fish inside mangrove channels because they used 7”-mesh size electro-welded plastic monofilament nets and hooks.

Photograph 15. "Guajabal" fishing cove, where bongo boats focused on fishing activities were observed

Motorized coastal artisanal fishing, PACM.- Definitely the main mode of fishing in the Project area of influence and in most fishing coves of the province of El Oro. It requires the work of fishermen in smaller boats (6.6-9m), mainly made of fiberglass, which are propelled by outboard motors ranging from 15 to 75Hp, and even vessels with 2 outboard motors were observed. The latter are used to fish out of port for periods of time below one day. This fishing mode involves the use of various nets. Electro-welded plastic monofilament (or MONO in Spanish) nets predominate with variable mesh size depending on the main target resource.

To describe the fishing operations and obtain variables from this fishing mode, the number of vessels at anchor on November 1 (Sunday before the Day of the Dead) was estimated, and most fishermen do not go sail on this day. Data from estimates of the artisanal fishing fleet and seafarers from previous research were kept in relation to fishing coves near Puerto Bolívar that could not be directly accounted for in this study.

The current estimate of Puerto Bolívar fishermen responds to the criterion of the maximum number of on-board crew members the different types of boats would have if all of them were in operating conditions. The estimate of the fleet and associated seafarers is observed in Table 3.

Table 4. Estimated number of artisanal fleet and seafarers

Fishing cove	Estimated number of vessels			2013 Estimate*	2013 INP estimate**	Current study
	Bongo boats (1.5 fishermen)	Wooden boat (2 fishermen)	Fiberglass boat (2.5 fishermen)			
Puerto Bolivar	17	28	943	2820	1825	2439
*La Puntilla***	*25***	*15***	*9***	*101*	*100*	
*Bajo Alto***	*50***	*120***	*5***	-	*414*	
Tendales	*20***	*14***		-	*120*	
Jambelí Beach	-	-	-	*50*	-	*50**
Total	17	28	963	2870	1825	2489

*Ecuambiente (2013). Oceanographic Component, fishing modes associated with the 2D seismic survey carried out by ENAP SIPEC in Block 3J Jambelí

**Marco Herrera, Romulo Castro, Dialhy Coello, Ingrid Saa and Esteban Elias (2013), Fishing coves and artisanal fishing settlements in Ecuador, Volume 2, Instituto Nacional de Pesca (National Fishing Institute), Special Bulletin Year 04 No. 1.

The boat types considered for fishermen estimates included bongo boats where 1 to 2 people would work. That is why and average value of 1.5 fishermen regularly work per Bongo boat, and 2-3 fishermen per fiberglass boat; so an average of 2.5 fishermen for each vessel is considered.

In this study, the number of 17 fiberglass boats counted out of the water was not entered since they remained in the fiberglass workshops. Vessels that would operate in “El Macho” estuary, in the northern sector of Machala or at the end of Huaylá estuary were not counted either because of security reasons upon following the advice of local fishermen who accompanied this activity and who recommended not to enter these marginal neighborhoods to carry out counts. However, fishermen claimed that there would be no more than 15 fiberglass boats and 20 boats propelled with small engines for pedestrian fishing and fishing in mangrove mouths. On November 1, the return and departure of vessels from Huaylá estuary were observed.

Thus, the margin of error in the estimate is considered between 50 and 60 minor vessels, that is, in the project area of direct influence, it could be stated that there are from 2,500 to 2,600 fishermen using the PACM mode.

Photograph 16. Left: Boats that lack compartments to preserve fish and require short trips. Right: Fiberglass boats of greater length with cellar-type compartments, the most widely used vessel in the artisanal fishing subsector in the area of influence.

Regarding the trends observed based on reviewed assessments, in 2013, the former Instituto Nacional de Pesca (National Fishing Institute) estimated that in Puerto Bolívar there were a total of 80 canoes or bongo boats, 180 wooden boats and 1200 fiberglass boats. Rounding and decreasing numbers for a period of 7 years are drawing attention. However, on Sunday May 12, 2013 (Mother's Day), the Ecuambiente consulting team recorded, in the same sector, a total of 44 bongo boats, 72 wooden boats and 870 fiberglass boats. If we consider the total number of vessels in this count, there were 986 vessels in the same sector, while 988 vessels were counted in this study. This situation shows the reconversion of the fleet, thus the number of bongo boats and wooden boats decreased and the number of fiberglass boats increased. The latter would have increased practically by 100 units in this period.

Regarding PACM mode fishing during November, data were recorded on fishing operations of 10 fiberglass vessels that set sail from the Huaylá estuary for daily activities. 250 fishing records were compiled in sheets similar to those used in 2013. After being entered into the freeware R and filtering similar data from 2013 to 2020 to remove fishing grounds reported exclusively in 2013, and despite the fact that in both periods the catches were not georeferenced, fishermen use common names for fishing sectors based on coastal demarcations and navigation buoys.

After filtering data, the universe of records in 2013 was reduced to 353 observations. Figure 3 shows general descriptions of both periods of time. From 2013 to 2020, the hours out of port have decreased. This leads to a decrease of total catch considering the different gears used and the variety of resources captured, which leads to a decrease in fishing profit.

Figure 3. General fishing variables in November 2013 and November 2020

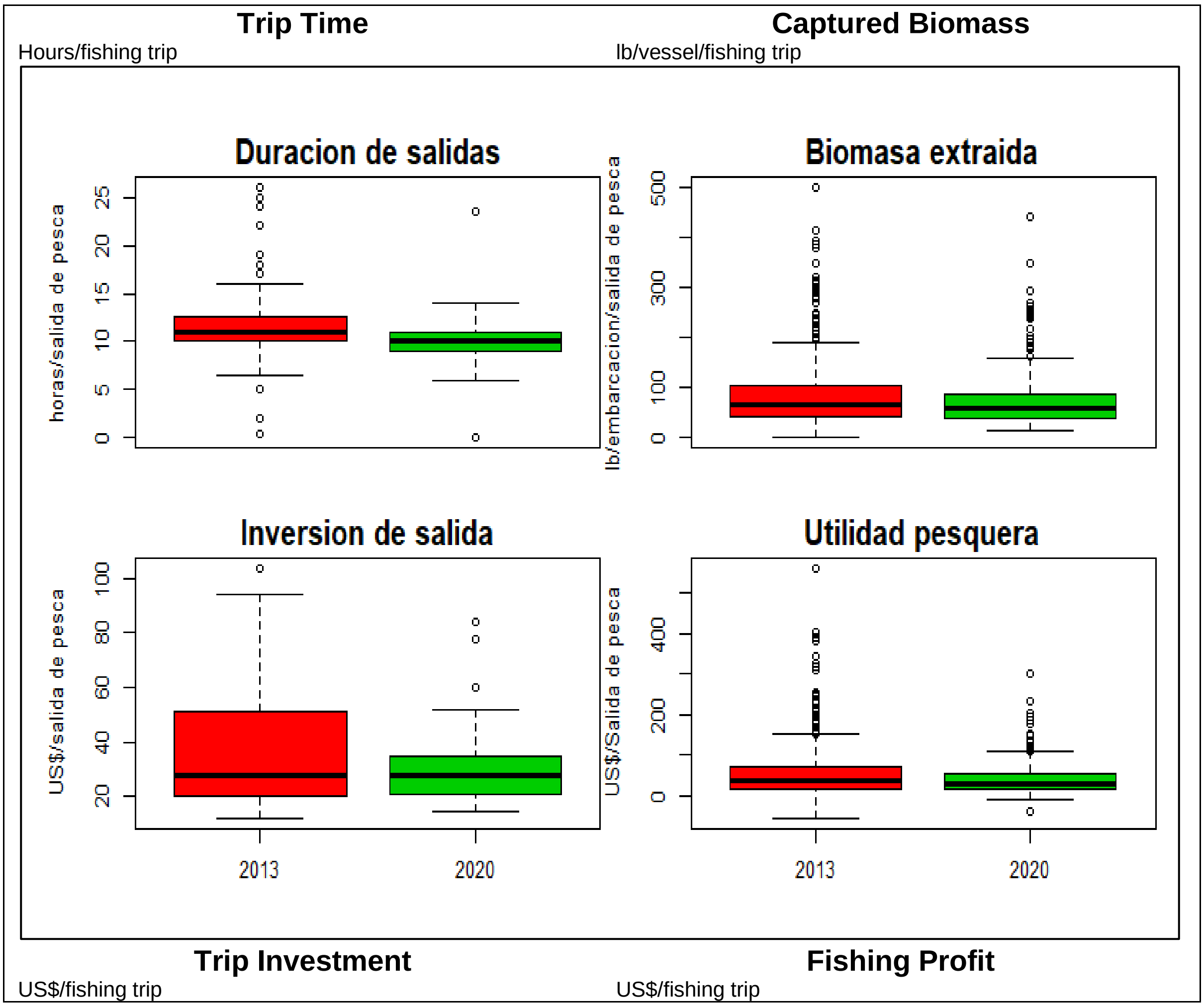


Table 5. PACM global fishing descriptions as set sail from Puerto Bolívar

Period	November 2013	November 2020
Time out of port (hours)	11.24±3.12	10.11±1.97
Catch, Total biomass (lb/fishing trip)	93.28±79.30	75.78±60.30
Trip expense or investment (US$/fishing trip)	37.80±22.13	31.3±15.07
Fishing profit (US$/fishing trip)	55.32±73.45	43.23±43.12

Figure 4. Main resources captured in PACM

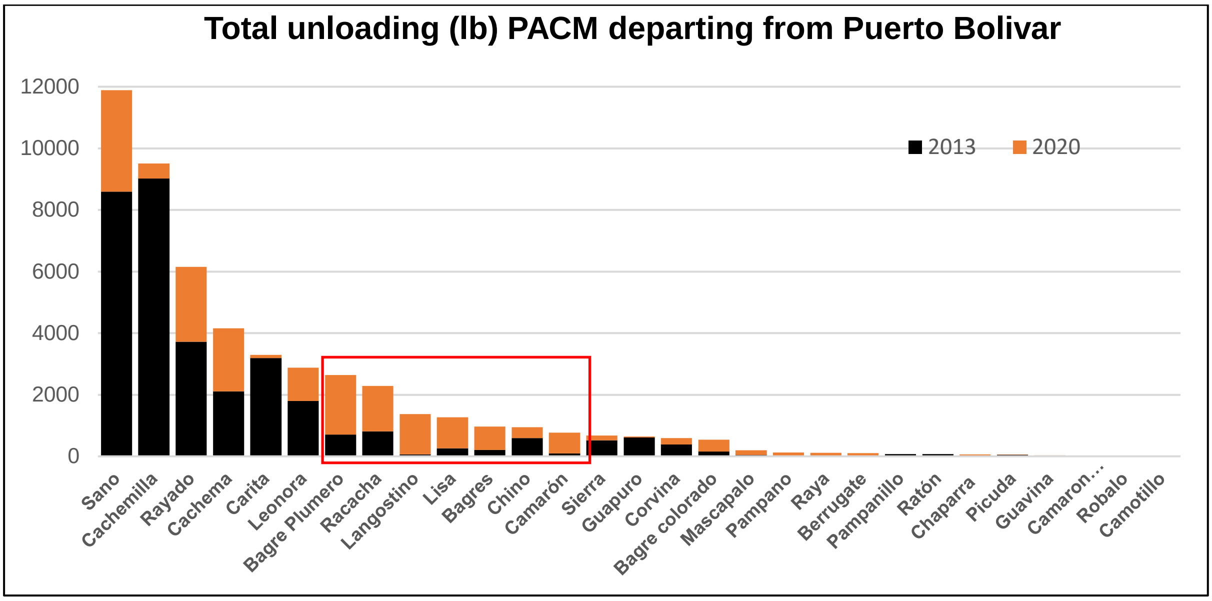


Figure 4 shows the abundance of catch of 29 resources as reported by fishermen. The wealth of resources captured is obviously greater and it is difficult to establish because of the way fishermen trade their catches in Puerto Bolívar. Certain resources have fixed first-sale prices., while other species are traded together based on a common size. Thus, a "Sano" encompasses fish from which up to 2 or 3 sections can be obtained if they are cut into medallions or cross sections to be put into a plate after being gutted, and a “Racacha” generally encompasses smaller fish and fish within a “Sano” that would have to be put in whole units in an inexpensive plate for lunch that costs around US$ 2.5 in Puerto Bolívar.

Figure 4 highlights target resources that would show a change trend in catches and are associated with resources that would have a greater relationship with the project area of direct influence since they are more coastal in nature and whose catch has increased as compared to 2013. The mean values of the main fishing variables observed in Table 4 show a decrease in fishing productivity after 7 years, and this situation can have various interpretations, in addition to the evident increase in the general extractive pressure for the area of influence, due to the increase in fiberglass boats. However, in the author's opinion, this decrease would also be related to a serious externality affecting artisanal fishing activity, i.e., piracy.

This assertion is based on the fact of the continuous pirate attacks during fishing operations in open sea as claimed in interviews with fishermen. This is the main problem identified by fishermen themselves which makes them restrict catch to daylight, work in groups and sail near the coastline. This situation is manifested in the reduction of the average time of trips observed in Figure 3, where a greater number of upper extreme values are observed in 2013, and a decrease of practically 1-2 trip hours is observed between both periods.

Among the resources exploited in the area of influence, the biggest fishing bet in the Jambelí Channel in the third quarter of each year is the capture of croaker/‘cachema’ *Scinoscion analis*. This species may be sold at US$ 100 in first sale if a large fish is caught using green electro-welded plastic monofilament nets with mesh size greater than 4.5” (usually 6”) or green twisted thread net. The total catch of croaker (large fish) reported was 382 lb in 2013 and 214 lb in 2020, and ‘cachema’, which is the same species with smaller size and can be captured with 2

¾" mesh-size nets, had a similar catch with 2107 lb reported in 2013, and 2050 lb in the current period.

Photograph 17. Croaker/cachema Scinoscion analis with first-sale price of US$ 2.8 in 2013 and US$ 2.9 in 2020

The second most attractive target resource for fishermen in the area of influence, which represents a lower risk of pirate attacks, is the shrimp *Penaeus vannamei*, which is caught with 2.5" – 2 ¾", 3" – 3.5" mesh size electro-welded plastic monofilament nets and has catch records that rose from a total of 67.5 lb in 2013 to 1307.8 lb in 2020, with maximum catches of 7.5 and 50 lb/boat/fishing trip respectively. Small shrimp ('camarones'), which encompasses individuals of the same species but smaller in size, reported total catches of 95.5 lb in 2013 and 668.75 lb in 2020 with maximum catches of 7.5 lb and 52.75 lb/boat/fishing trip respectively.

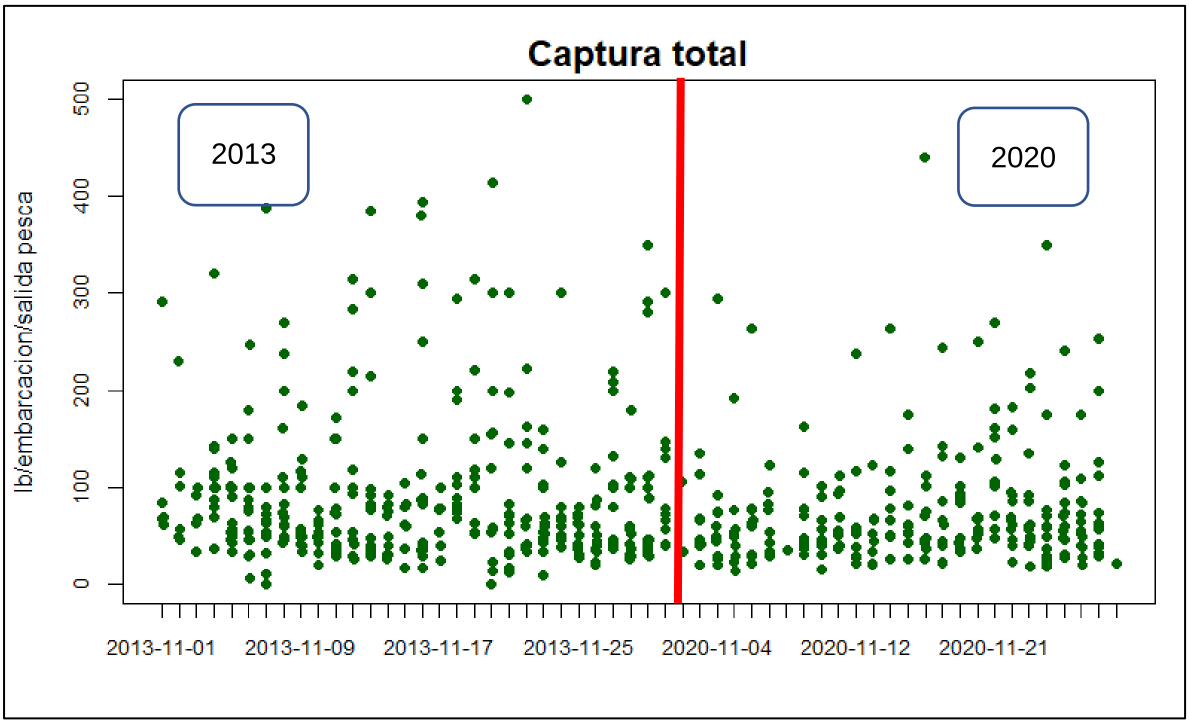
Photograph 18. As for shrimp Penaeus vannamei, a full 20-liter bucket is considered a good catch. "20 units per bucket is a very good catch", said the fishermen. Shrimp had a maximum price of US$ 5.5 in 2013 and did not exceed US$ 4 in 2020

Fish of the *scianidae* family represent the largest natural supply of well-marketed fish since these fish have different prices from ‘Sano’ to ‘Racacha’, although specimens of ‘Rayados’ and ‘Ratones’ are part of a ‘Sano’ because they are medium-sized.

Photograph 19. Top-rated sciaenid species from top to bottom: Croaker/’cachema’ Scinoscion analis, yellow croaker Scinoscion albus and Chinese croaker Nebris occidentalis

A time series of data of catches by a vessel in a fishing trip is observed in Figure 5. It is observed the influence of tidal cycles showing sinusoidal trends associated with cycles of higher productivity related to periods of spring tide ('aguajes'), where tidal currents acquire greater speed, and the intertidal height is amplified. During spring tide, the tide rises and falls rapidly, while during neap tide ('quiebras'), the intertidal rise and fall takes longer.

Figure 5. Fishing productivity fluctuations in November 2013 and 2020



Lb/vessel/fishing trip, Total catch

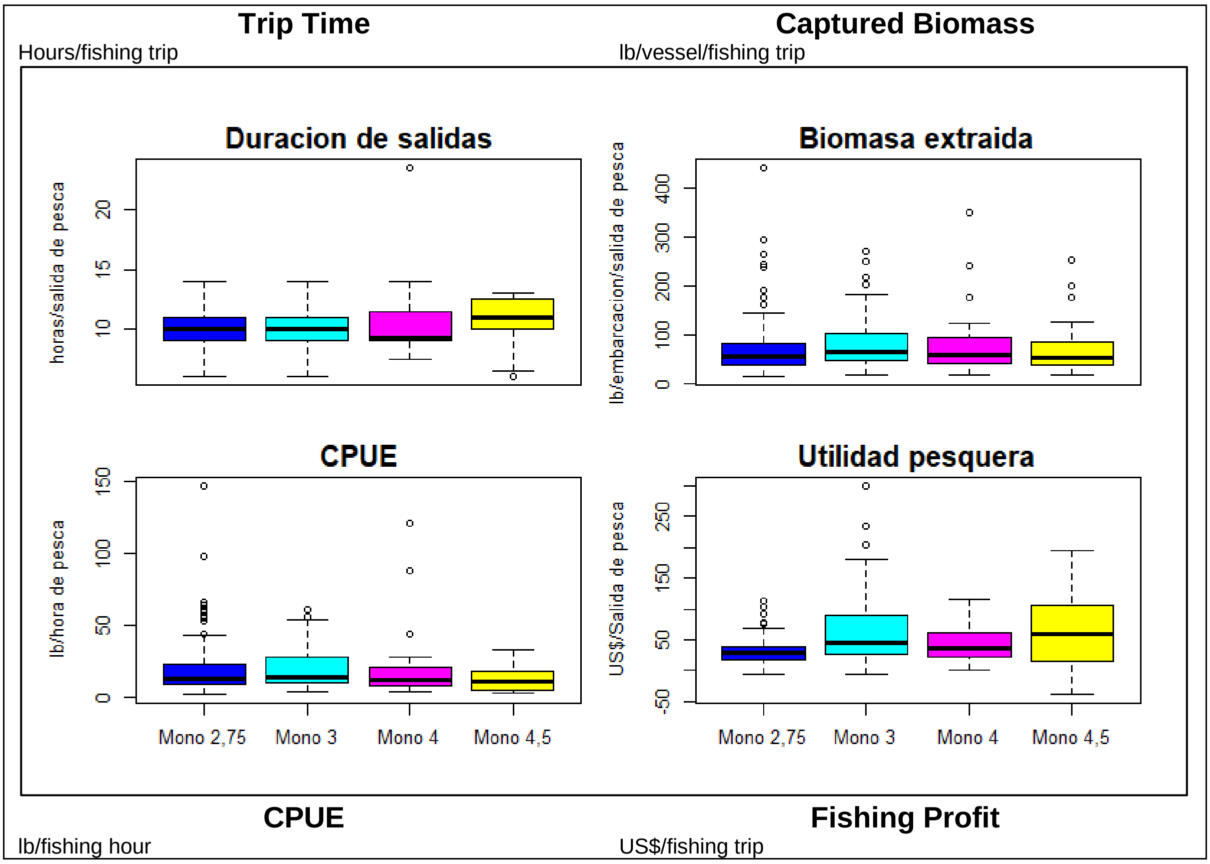
Figure 5: Fishing productivity fluctuations in November 2013 and 2020

During collection of fishing information for this period, improvements were achieved for the analysis of fishing productivity. In the 2013 sheets, fishermen only reported data on time out of port as total time of daily fishing work. In this period, it was urged to record the effective working time of fishing gear, that is, fishermen reported the number of times fishing gear was mounted and the average time of use. Therefore, the time of gear underwater or effective work could be estimated. After the effective working time and the total catch mass were known, it is feasible to estimate the CPUE[6], in lb of catch per working hour. The main fishing variables categorized by fishing gear in 2020 are shown in Table 5 and Figure 6, respectively.

Table 6. Fishing variables associated with the main gears used in the project area of influence.

Variable/Fishing Gear	**2 ¾" Monofilament**	**3" Monofilament**	**4" Monofilament**	**4.5" Monofilament**
No. of records	145	52	23	30
Time out of port	9.96±1.55	10.14±1.70	10.54±3.32	10.78±1.90
Average catch (lb/fishing trip)	71.37±58.52	87.22±59.28	84.81±77.63	70.39±55.11
CPUE (lb/fishing hour)	19.18±18.86	19.90±15.45	21.46±28.09	12.95±9.02
Profit (US$/vessel/fishing trip)	30.57±20.46	66.21±64.54	44.78±30.74	63.42±60.60

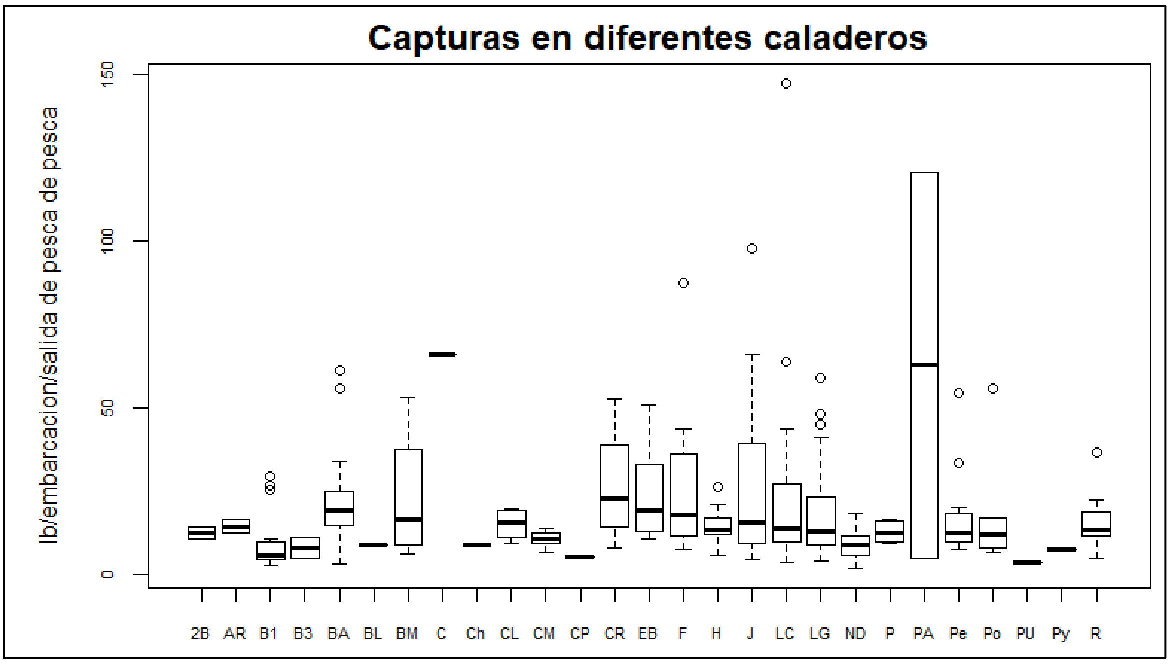
Figure 6. Fishing variables classified by fishing gear used in PACM in November 2020



[6] Catch per unit of effort

Figure 7. Catches classified in different fishing grounds in November 2020: 2B= 2 buoys, AR= Outside the river, B1= Buoy 1, B3= Buoy 3, BA = Bajo Alto, BM= Boya Amarilla, C= El Coco, Ch = Chupadores, CL= Cabeza de Loma, CM= Canal del Medio, CP= Caña Parada, CR= Costa Rica, EB= El Bravo, F = El Faro, H= Las Huacas, J= Jambelí, LC= Loma Chica, LG= Loma Grande, ND= Not determined, P= La Poza, PA= Punta Arena, Pe= El Petrolero, Po= La Polanca, PU= La Puntilla, PY= Punta Payana, R= El Rio

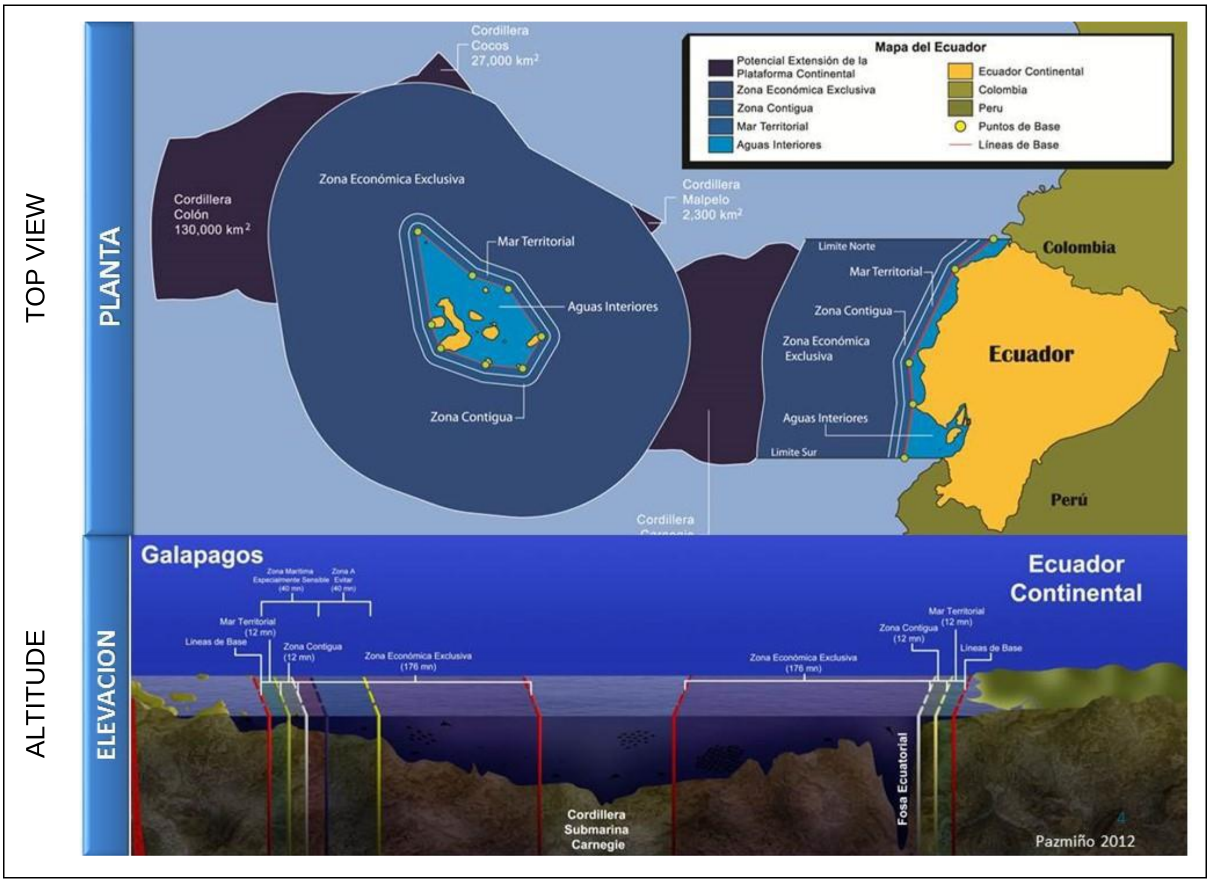
Catch at different fishing coves



Lb/vessel/fishing trip

Artisanal open-sea fishing, PAA: This modality differs from PACM in that fishing trips are more distant from the coast. The criterion to establish the limit between coastal or neritic waters and oceanic waters is the presence of the continental slope, that is, the distance from the coast where the continental platform ends, and the depth is increased as seen in Figure 8.

Figure 8. Jurisdictional maritime spaces of Ecuador, as taken from the Plan for the Management of Coastal Marine Space. (SENPLADES, 2016)



Based on the criteria for the marine-coastal zoning of Ecuador, the entire Gulf of Guayaquil would correspond to coastal waters. However, in terms of fishing operations, it could be assumed that the starting limit of oceanic waters is beyond 20 nautical miles from the coast. Fishing activities in oceanic waters or "open sea" require greater logistics and investment, and fuel use can exceed 100 gallons and generally involve the use of 8 or 9-inch trammel nets, or multiple hooks mounted on spools. Oceanic trips generally take longer than 18 hours out of port, and trips taking up to 4 days are generally planned. In Ecuador, artisanal fishermen make trips beyond 200 miles or the Exclusive Economic Zone (EEZ).

However, this fishing method is not regularly used in the Province of El Oro, although it could be considered that fishing operations in the vicinity of Santa Clara or beyond the gas platforms of Block 6 could be considered oceanic since there is no intertidal mixing of waters. These sectors are characterized by very transparent waters with a dark blue color that can be seen from a distance, unlike the light color of coastal waters.

Industrial fishing, PI: Fishing operations carried out in vessels with greater length and draft with decks and superstructures allowing the work of crews of several people. In Ecuador, this fishing type differs from artisanal fishing because fishing gear is handled by machines, while artisanal fishing is carried out through the physical labor of fishermen.

According to the document ‘Puertos, Caletas y Asentamientos pesqueros artesanales del Ecuador’ [Ports, Coves and Artisanal Fishing Settlements in Ecuador] (INP, 2014), in 2013, 85 industrial ships operated in Puerto Bolívar, and on Sunday, November 1 of this year, 84 boats tied alongside or at anchor in docks of the Huaylá estuary were counted.

Photograph 20. Industrial vessels of different lengths and sizes observed on November 1

Conversations with industrial vessel crew members show that regularly the crew in these vessels ranges from 6 to 9 people. Therefore, the number of industrial ship crews could exceed 500 seafarers. The main fishing operation of this fleet is capture with seine nets, and these vessels are locally called “bolicheros”.

Information on industrial catches from first source could not be accessed, and publicly accessible statistical reports generated by the IPIAP[7] are out of date and present general data of the total monthly catch by species, without specifying the ports of unloading.

When reviewing the compiled report for the period 2004-2017, there are reports of species classified as small pelagic, which include records in Metric Tons: Southern sardine *Sadinop sagax*, Mackerel *Scomber japonicus*, Round sardine *Etrumeus teres*, ‘Chuhueco’ *Cetengraulis misticetus*, ‘Pinchagua’ *Opisthonema sp*, Anchovy *Engraulis ringens*, ‘Botellita’ *Auxis spp*, Horse mackerel *Trachurus murphyi* and ‘Picudillo’ *Decapterus macrasoma*.

A second category called “Others” includes 25 fish recorded in 2017 with common names. The 10 most captured resources of that period included ‘Corbatas’, ‘Barriga Juma’, ‘Trumpetas’, ‘Lisa’, ‘Gallineta’, ‘Menudo’, ‘Carita’, ‘Hojita’, Rabo Blanco’ and ‘Chazo’. This situation would be linked to an existing conflict between artisanal and industrial fishermen – the invasion of industrial vessels that carry out fishing operations within the 8-mile coastal strip, determined as a Fishing Zone for decades and ratified as artisanal in the Organic Law for the Development of Fishing and Aquaculture of April 17, 2020, whose Article 104 sets out:

“Area for Artisanal Fishing. *Declare an area for artisanal fishing, extending within eight nautical miles. This area allows for catch of bioaquatic species, from the low-water line along the continental coast of Ecuador towards the sea, except for the reserve mile as provided in this Law.*

[7] Instituto Publico de Investigación en Acuicultura y Pesca [Public Institute for Aquaculture and Fishing Research] (formerly Instituto Nacional de Pesca INP)

The corresponding geographical coordinates and their respective reference points will be established by ministerial resolutions issued by the governing body. These coordinates shall set out the allowable fishing operations and fishing gear, the reserve areas, the areas called 'corralitos' (little pens) and other measures of fishing management.

Based on available scientific evidence and on the socioeconomic results of the fishing activity, according to the fishing type, fishing management systems, allowable catch quotas, fishing seasons and zones, regulation of fishing efforts, fishing methods, minimum catch sizes and other regulations that require the preservation and rational exploitation of hydrobiological resources, the governing body may extend – but may not reduce – this area beyond 8 nautical miles, with the aim of safeguarding the conservation of hydrobiological resources.

In this area, industrial fishing activity is prohibited, except for the extraction of Titi shrimp in the areas called 'corralitos'. The following activities will be exclusively allowed: a) Extraction or capture of fish, crustaceans and mollusks by artisanal fishermen; b) Activities of artisanal mariculture in the areas assigned for it; and c) Extraction of existing resources under all forms of fishing, solely for scientific purposes."

The continuous invasions of industrial boats in search of better catches near the coast, has led to clashes between artisanal and industrial fishermen. Assaults on industrial vessels by artisanal fishermen were reported, with 20 reports of these events during the first half of 2017. This was the cause of the strike of artisanal fishermen in Puerto Bolívar on August 17, 2018, where they blocked the passage of vessels to the Huaylá estuary (El Telégrafo, 2017), and incidents involving infiltrators who looted and attacked the Captaincy's offices of the Ecuadorian Navy in Puerto Bolívar were recorded.

Another aggravating factor in this conflict were recurrent events of small pelagic fish, mainly 'carduma' or 'chuhueco' *Cetengraulis misticetus* that appeared floating near the mouth of the Santa Rosa estuary and that were presumably discarded from industrial vessels because of the opportunity of more profitable catches.

Photograph 21. Fish Cetengraulis misticetus aground in Jambelí beach "We believe that an industrial fishing vessel took a school of this fish and threw it into the sea," said Jorge Luis Vaca, Chairperson of the Jambelí Parish Council. (El Universo, 2014).

3.2 Regulation and support services: The role of mangroves in coastal estuaries

Coastal wetlands comprise communities of characteristic plant formations such as mangroves, marshes, and cyanobacterial mats, which are often distributed as zones parallel to the coastline, responding to elevation gradients that determine the frequency of tidal flooding (Robertson and Alongi, 1992).

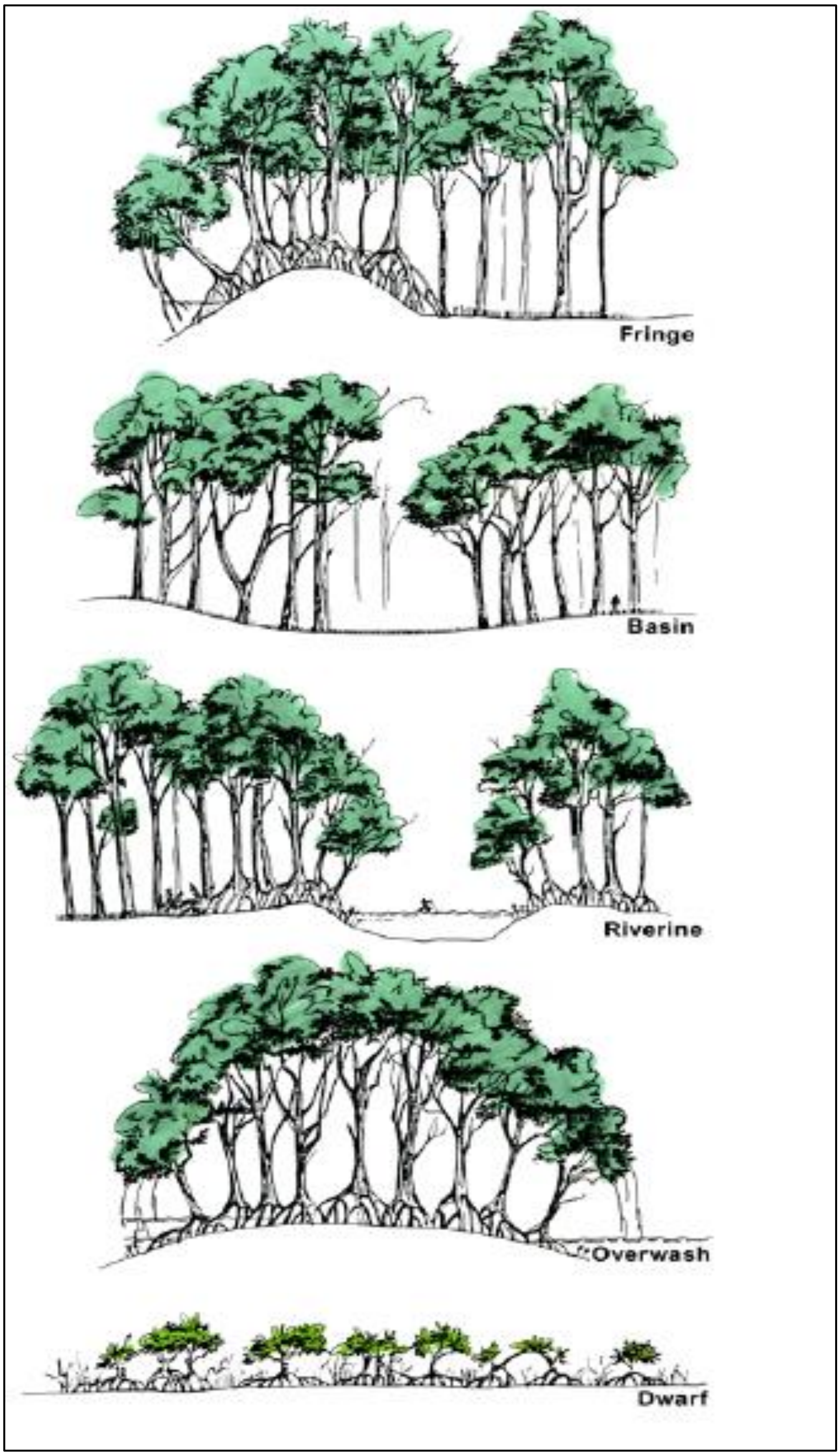
Mangroves are a characteristic type of coastal wetland occurring in the tropical and subtropical intertidal zones and are made up of facultative tree formations or thick halophytic plants (Ball and Farquhar, 1984). They have in common a wide variety of morphological, physiological, and reproductive adaptations that allow them to inhabit extreme environments with an unstable substrate, high contents of organic matter, high temperatures, large fluctuations in salinity and low oxygen concentrations. (Tomlinsom 1986, Hutchings and Saenger, 1987).

In Ecuador, mangroves dominated by Rhizophora are flooded 700 times per year, while those dominated by *Laguncularia*, *Avicennia* and *Conocarpus* are flooded half the time (Bodero, 1993). *Rhizophora mangle* has full exposure to tidal variation and its long supporting roots extending from the trunk and branches stand out, forming frameworks that increase its stability and trap sediments. At a higher altitude, there is the black mangrove *Avicennia germinans* that has long horizontal roots with protrusions called pneumatophores, which emerge and remain exposed to the air and contribute to the stabilization of soils and oxygen supply for underground roots, often found in anaerobic sediments. At a higher altitude and towards the interior of the mangroves, there is the white mangrove *Laguncularia racemosa*, which lacks aerial roots. However, when found in sediments that are poor in oxygen or remain flooded for long periods of time, they often develop peg roots.

Mangroves colonize protected areas along the coast such as deltas, estuaries, lagoons, and islands. The topographic and hydrological characteristics within each of these configurations define a series of different mangrove ecological types (Hoff et al, 2014). The most common ecological types include fringe mangroves, riverine mangroves, basin mangroves, flooded mangroves, and dwarf mangroves (Lugo and Snedekar, 1974; Twilley, 1998), as observed in Figure 9.

The mangrove strips border protected coastlines, channels and lagoons and are flooded by daily tides. Riverine forests flank river channel estuaries and are periodically flooded with nutrient-rich brackish and fresh water. The drainage depressions are located in the interior of the mangrove areas and are home of basin forests, characterized by stagnant or slow-flowing water. Overwash mangroves are frequently located in flooded islets, and dwarf or scrub forests grow in areas where hydrology is restricted, presenting conditions of high evaporation, high salinity or low nutrient status.

Figure 9. Ecological types of mangrove forests, from top to bottom: fringe mangroves, basin mangroves, riverine mangroves, overwash mangroves, and dwarf mangroves (Hoff et al, 2014).



Mangroves provide important environmental services, highlighting the improvement in the management of small-scale commercial fisheries (Hutchison, Spalding and Ermgassen, 2014; López-Angarita et al, 2018), protection against river flooding, stabilization of the coastline, water purification and wastewater treatment and protection against waves (Hamilton and Collins, 2013).

Mangrove forests contribute to the stabilization of the coastline as they represent sediment deposition sites; increased sedimentation can result in the expansion of mangrove habitats. Its framework of roots and stems improves sediment retention, which in turn promotes the growth and expansion of mangroves (Furukawa and Wolanski, 1996).

This accretion of mangroves is the result of increased friction and reduced speed of tidal currents (Woolanski et al, 1992). At the same time, roots and stems generate turbulence that keeps fine sediments in suspension to enter mangrove forests with tidal flooding (Shanbuding et al, 1999). As the tidal flow enters the mangroves, the current decreases, and in the period close to high tide, the current speed approaches zero and flocs are deposited (Furukawa *et al.*, 1997). Sedimentation and accretion processes can be rapid, with vertical accretion of 4 cm year^{-1} recorded in some sites (Alongi *et al.*, 2005).

Mangroves surround coastal plains making up estuarine, and deltaic deposits, and other depositional formations, and are limited to a narrow altitude range within intertidal height (Mckee *et al.*, 2012). The areas of suitable intertidal habitats are called accommodation spaces that occur depending on the state or maturity of mangroves and the geomorphological complexity of larger depositional systems.

An assessment of sediment retention in mangroves in south-west Queensland showed that riverine mangroves had a more homogeneous sediment distribution in the intertidal zone than the tidal mangroves (overwash mangroves) where most of the sedimentation occurred in the marginal zone. The mangrove strip areas retained most of the sediments that entered during a tidal cycle with 0.90 ± 0.22 mg cm^{-2} syzygy tide^{-1} representing 52 ± 12.5% of the total estimated sedimentation (Adame *et al.*, 2010).

Mangrove distribution on the coastline changes over time and involves a subtle balance between accretion and subsidence, erosion and vegetative stabilization, productivity and decay, tidal flooding, and drainage efficiency (Fitzgerald *et al.*, 2008). Observed and forecasted rates of sea level rise (SLR) could generate impacts on mangroves. This situation raises concern that these wetlands are vulnerable to drowning and coastal compression (Phan *et al.*, 2015). However, recorded rates of sediment accumulation under subtropical mangroves have shown rapid accretion, which in several cases would be faster than rates of sea level rise (Krauss *et al.*, 2014; Mackenzie *et al.*, 2016).

Sediment retention in mangroves protects other marine habitats and is associated with maintaining water quality by filtering sediments, minerals, pollutants, and nutrients from riverine and tidal waters. Mangroves have wide ranges of tolerance to salinity and levels of contamination. However, there are critical thresholds for salinity, the content of heavy metals, organic compounds containing chlorine and sediments, beyond which mangrove will become extinct (Snedekar and Brown, 1981).

Mangroves are complex ecosystems, with high primary productivity, efficient nutrient recycling, and permanent exchange between terrestrial and marine ecosystems as characteristic features (Jennerjahn and Ittekkot, 2002). Despite its high litterfall production and export rates, mangrove debris has been reported to be of little importance in maintaining marine food webs. The geographical distribution of organic matter (OM) derived from mangroves in marine sediments is restricted to its vicinity. Mangroves receive dissolved nutrients from the sea and land, but these inputs are not enough to maintain their high productivity, which can exceed 7,000 mg C m^{-2} per day (Alongi *et al.*, 1992, Bunt, 1992). Internal OM recycling is an important factor to satisfy this high nutrient demand (Holguin et al, 2001). Furthermore, mangrove leaves play a key role in this process as they contain up to 40% water-soluble components that can be converted into bacterial biomass in less than 8 hours after falling into the water (Benner *et al.*, 1986). Crabs recycle and bury mangrove leaves (Robertson and Daniels, 1989), and as a consequence, large amounts of macro detritus and dissolved substances can be exported to adjacent waters.

The increase in biodiversity is another ecosystem service associated with these plant formations. The framework of roots, pneumatophores and submerged branches of mangroves generate nurseries. These are a "habitat for a particular species that contributes proportionally with a greater number of individuals than the average of adult individuals per unit area generated by other habitats used by juveniles" and have ecological importance in the general maintenance of ecosystem functions (Dahlgren *et al.*, 2006).

Beck *et al.* (2001) hypothesized the abundance of food as the main causes of the high number of juvenile fish and shrimp in mangroves, lower predation pressure in shallow aquatic microhabitats with increased turbidity and reduced visibility relative to nearby unvegetated habitats and their complex physical structure. These factors would act synergistically to cause the nursery role of mangroves, increasing the density, growth and survival of juvenile fish and invertebrates.

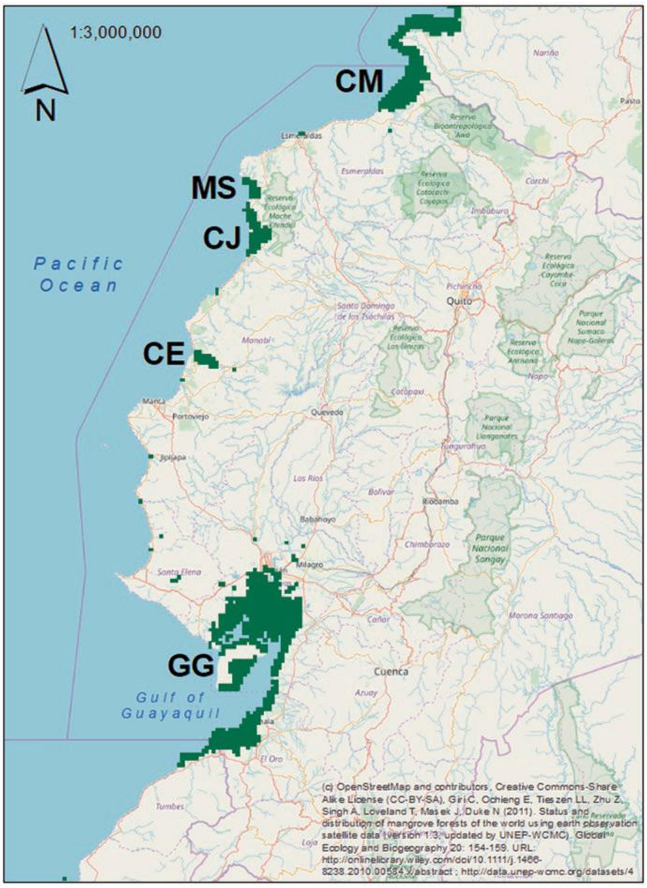
Hutchinson, Spalding and Ermgassen (2014) argue that the provision of food and refuges in mangroves improves fish production in general, i.e., its high primary productivity provides the basis for food chains that enhance the growth of fishing resources and, at the same time, the three-dimensional structures of channels, pools and complexity of submerged roots and branches provide protection against predation as well as shading and reduce water flows. Hamilton and Snedekar (1984) estimated that 80% of the fish caught in Florida's commercial and sport fishing activities were dependent on mangroves. Furthermore, Paw and Chaw (1991) determined that 72% of commercial fishing catches in the Philippines depended on mangroves. Mangrove fishing productivity has exceeded US$ 18,000 ha/year (De Groot *et al.*, 2014).

Mangroves are scarce and important in ecosystem terms. Their global coverage amounts to 154,085 km^2 (Hamilton and Casey, 2016), representing 1% of the total area of tropical forests, and 0.4% of the global forest coverage (FAO, 2007; Van Lavieren *et al.*, 2012; Sanderman *et al.*, 2018). Tropical forests are the richest in carbon per unit area, containing approximately 1023 Mg carbon*ha^{-1} (Donato *et al.*, 2011), and these forests sequester 3% of atmospheric carbon.

These forests are disappearing faster than internal forests and coral reefs (Duke et al, 2007). The decline is mainly caused by the development of activities in agriculture, aquaculture, tourism, urban development, and its own over-exploitation. In the last century, 50% of the planet's mangroves have been lost, and in the period 1980-2000, 35% of their global coverage would have been lost (Giri *et al.*, 2011).

In Ecuador, there are 161,835 ha of mangroves (MAE, 2017) that represent 8% of South American mangroves, which in turn are 11% of the world mangrove coverage (Giri *et al.*, 2011). Mangrove conservation has been controversial due to the excessive installation of shrimp farms in areas that were previously mangroves and the continuous demands of fishermen, shellfishers and social activists demanding mangrove recovery (Ocampo-Thomason, 2006; Veuthey and Gerber, 2012; Latorre, 2014).

Figure 10. Sectors in Ecuador that host mangroves include CM= Cayapas Mataje, MS= Muisne, CJ= Cojimíes, CE= Rio Chone, GG= Gulf of Guayaquil. (Hamilton, 2019)



According to the laws of Ecuador, mangroves are a public good and an object of conservation. The main policy for their conservation is to grant concession on mangrove areas to associations of fishermen, shellfishers and tourism entrepreneurs (Rodríguez, 2018). The former Subsecretaría de Gestión Marino Costera [Undersecretariat of Coastal Marine Management, or SGMC by its acronym in Spanish] was responsible for these processes called Agreements for Sustainable Use and Custody of Mangroves (AUSCM), which are based on the rights of ancestral use of fishing lands and a form of co-management that ensures access to communities dependent on fishing resources (Beitl, 2017).

The National Action Plan for the Conservation of Mangroves of Mainland Ecuador (Carvajal and Santillan, 2019) was established in 2019 and stated: *"In areas of influence (buffer) of the mangrove ecosystem, implement actions that promote the transition to sustainable production systems. By improving productivity and promoting the adoption of good agricultural, forestry and aquaculture practices."*

The installation of shrimp ponds in mangroves has been prohibited since 1978. However, mangrove clearing for this purpose has continued for 2 decades, and since 2011, Resolution 056 is in force, which involves a fine of US$ 89,273.01 for each hectare of affected mangroves. This value in considered loss of environmental goods and services and a cost of restoration. This instrument allowed the initiation of multiple legal processes and managed to stop the production of mangrove charcoal.

Hamilton (2019) deepens the changes that occurred in estuaries with mangroves on the Ecuadorian coast. The changes of the last century are shown in Figure 11.

Figure 11. Evolution of mangrove cover recorded in hectares in the period 1969-1999. Excerpted from Hamilton, 2019.

Table 1.3 Ecuadorian mangrove forest cover by year and province when available, 1969–1999

Year/Hectare	Esmeraldas	Manabí	Guayas	El Oro	Total	Author
1969	32,343	12,099	122,615	35,144	202,201	CLIRSEN (2007)
1979					203,700	Parks and Bonifaz (1994)
1980					203,000	UN FAO (2004)
1984					182,100	Parks and Bonifaz (1994)
1987	29,257	6401	116,065	23,403	175,126	CLIRSEN (1987)
1987					237,700[a]	Spalding et al. (1997)
1990					163,000	(UN FAO 2004)
1991					196,000	UN FAO (2004)
1991	23,969	6953	109,928	20,918	161,768	Bodero (1993)
1991					177,600	Harcourt and Sayer (1996)
1992			109,000		246,900[b]	Spalding et al. (1997)
1999	23,189	1797	104,586	18,911	148,483	CLIRSEN (2007)
1999					149,556	UN FAO (2007)

Figure 12 shows that the province of El Oro practically lost 50% of its mangrove cover in the period 1969-2020. Stuart Hamilton is one of the greatest researchers of mangrove loss in Ecuador and worldwide. Table 6 shows environmental services that would be obtained from mangroves worldwide according to Stuart Hamilton.

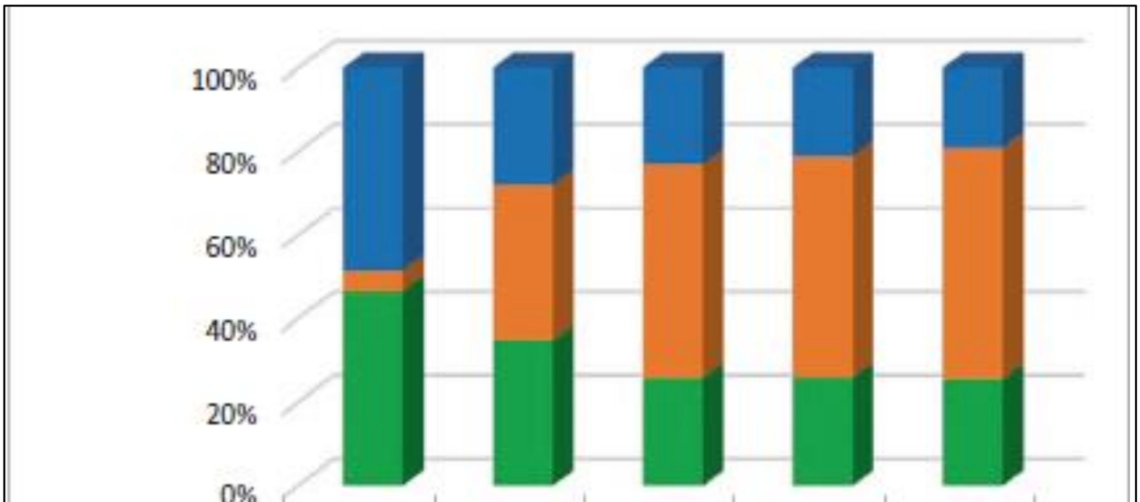
Table 7. Environmental services provided by mangroves according to Hamilton's classification.

Food	**Wood**	**Mitigation**	**Habitat**	**Others**
Wild shrimp	Coal	River flood control and protection	Diversity maintenance	Tourism
Fish	Firewood	Stabilization of the coastline	Fish farm	Recreation
Fish bait	Boats	Wind protection	Habitat for juveniles	Medicinal plants
Mollusks/clams	Posts	Water treatment	Migratory bird habitat	
Crabs	House construction	Waste treatment	Coral habitat support	
Traditional aquaculture products	Thatched roofs	Carbon sequestration	Pollinating bats and bees	
Shellfish	Smoked fish	Groundwater management		

Edible rinds		Treatment of pollutants from agriculture		
Edible plants		Storm surge and tsunami protection		
Pollinating species				
Sugar				
Honey				
Alcohol				

The province of El Oro has had a devastating loss of mangroves whose temporal evolution is shown in Figure 12.

Figure 12. Changes in land use from 1977 to 2014 in the province of El Oro. Please note that mangroves were practically reduced by half in 37 years (Hamilton, 2019).



	1977	1985	1997	2006	2014
Other LULC	48%	28%	23%	21%	19%
Shrimp Farms	5%	37%	51%	53%	55%
Mangrove Forest	47%	35%	26%	26%	26%

The remaining mangroves have been granted in concessions to fishing-related civil society organizations, with a national total of 68,055.93 ha of mangroves granted in Agreements for Sustainable Use and Custody of Mangroves (AUCEMS) with 23 10-year concessions located in the province of El Oro.

Table 8. Mangrove area granted in concessions by the former Subsecretaría de Gestión Marino Costera [Undersecretary of Coastal Marine Management, or SGCM], update June 2019

Province	No. of Agreements	Hectares of mangroves granted in Custody	%
Guayas	24	52581,49	77.26%
Esmeraldas	5	826,82	1.21%
Manabí	2	61,8	0.09%
El Oro	23	14585,82	21.43%
Santa Elena	0	0	0.00%
Total	54	68055,93	

Based on these background, it is suggested to pay close attention to the management of mangroves in this Project. Some identified remaining mangroves could be affected by the expansion to the north of the current Dock 6.

4. REFERENCES

Adame, M. F., Neil, D., Wright, S. F., & Lovelock, C. E. (2010). Sedimentation within and among mangrove forests along a gradient of geomorphological settings. Estuarine, Coastal and Shelf Science, 86(1), 21–30.

Alongi D. M., Boto, K.G. and Robertson, A.I. (1992) Nitrogen and phosphorus cycles. In: Robertson AI, Alongi DM (eds) Tropical mangrove ecosystems. (Coastal and estuarine studies 41) AGU, Washington, pp 251–292

Alongi, D. M., Pftitzner, J., Trott, L.A., Tirendi, F., Dixxon, P. and Klumpp, D.W.(2005). Rapid sediment accumulation and microbial mineralization in forest of the mangrove *Kandelia candel* in the Jiulongjang Estuary, China. Estuarine Coastal and Shelf Science 63:605-618.

Ball, M.C., Farquhar C (1984).Photosynthetic and stomatal responses of the grey mangrove,

Avicennia marina, to transient salinity conditions. Plant Physiology 74: 7-11 pp

Beitl,Christine M. 2017, Decentralized mangrove conservation and territorial use rights in Ecuador´s mangrove-associated fisheries. Bulletin of Marine Science, Volume 93, Nuber 1, January 2017. Pp 117-136

Bodero, A. (1993). Mangrove ecosystems of Ecuador. In L. D.Lacerda (ed.), Conservation and Suistanable utilization of mangrove forest in Latin America and Africa Region. Part 1-Latin America. International Society for Mangrove Ecosystems. Yokohama, Japan.

Bunt, J. S. (1992) How can fragile ecosystems best be conserved?. In: Hsü KJ, Thiede J (eds) Use and misuse of the seafloor. (Dahlem workshop reports: environmental science research report 11) Wiley, Chichester, pp 229–242

Carvajal R. and X. Santillán. (2019). Plan de Acción Nacional para la Conservación de los Manglares del Ecuador Continental. Ministerio del Ambiente de Ecuador, Conservación Internacional Ecuador, Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO) y la Comisión Permanente del Pacífico Sur (CPPS). Proyecto

Conservación de Manglar en el Pacífico Este Tropical. Guayaquil, Ecuador

Dahlgren, C.p., Kellison, G.T., Adams, A.J., Gillanders, B.M., Kendall, M.S., Layman,C.A., Ley,J.A.Nagelkerken, I.and J.E.Serafy (2006).Marine nurseries and effective juvenile habitats:concepts and applications. Marine Ecology Progress Series Vol.312:291-295,2006.

De Groot, R., Brander,L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., . Christie,

M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S.,Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., Ten Brink, P. and P. Van Beukering (2012). Global estimates of the value of ecosystems and their services in monetary units. Ecosystems services 1 (2012)50-61. http://dx.doi.org/10.1016/j.ecoserv.2012.07.005.

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham,M. and M. Kanninen (2011). Mangroves among the most carbon-rich forest in the tropics. Nature Geosciences Letters doi:10.1038/NGEO1123

Duke, N.C., Meynecke, J. O. S., Dittmann, A.M., Ellison, K., Anger, U., Berguer, S., Cannicci,

K., Diele, K.C., Ewel, C.D., Field, N., Koedman, S.Y., Lee, C., Marchand, I., Nordhaus, F. and Dahdouh-Guebas. (2007). A World without Mangroves? Science, 317(5834),41b-42b. letter doi:10.1126/science.317.5834.41b.

El Telegrafo 2017. Puerto Bolivar afronta paro de pescadores https://www.eltelegrafo.com.ec/noticias/regional/1/puerto-bolivar-afronta-paro-de-pescadores

El Universo (2014). Peces muertos hallados en 5 kilomettos de Playa Jambeí. https://www.eluniverso.com/noticias/2014/09/10/nota/3806216/peces-muertos-hallados-5-kilometros-playa

FAO (2007) The world's mangroves 1980–2005. FAO Forestry Paper. FAO, Rome, Italy

FitzGerald D.M., Fenster M.S., Argow B.A., Buynevich I.V. (2008). Coastal impacts due to sea-level rise. Annu. Rev. Earth Planet. Sci. 36:601–47

Furukawa, K., Wolanski, E., 1996. Sedimentation in mangrove forests. Mangroves and Salt Marshes 1, 3–10.

Furukawa, K., Wolanski, E., Mueller, H., 1997. Currents and sediment transport in mangrove forest. Estuarine Coastal and Shelf Science 44, 301–310.

Giri, C., Ochieng, E., Tieszen, L.L., Zhu, Z., Singh, A., Loveland, T. J. & Masek and Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. Global Ecology and Biogeography, 20(1), 154–159. https://doi.org/10.1111/j.1466-8238.2010.00584.x

Hamilton L.S. and Snedaker,S.C. (1984). Handbook for Mangrove Area Management. East West Center, Environment and Policy Institute, UNESCO, IUCN and UNEP ,140 pp.

Hamilton, S. E., and Collins, S. (2013). Livelihood responses to mangrove deforestation in the northern provinces of Ecuador. Bosque, 34(2), 143-153.

Hamilton, S. E., and Casey, D. (2016). Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century (CGMFC-21), 729–738. https://doi.org/10.1111/geb.12449

Hamilton, S.E. (2019). Mangroves and Aquaculture. A five decade remote sensing Analysis of Ecuador´s Estuarine Environments. Coastal Research Library 33. ISBN 978-3-030-22240-6. https://www.springer.com/gp/book/9783030222390

Herrera marco, Castro Romulo, Coello Dialhy, Saa Ingrid y Esteban Garcia (2014). Puertos, caletas y asentamientos pesqueros del Ecuador Tomo 1 Boletín especial Año 4 N°1. Instituto Nacional de Pesca INP, 327 pp. Guayaquil Ecuador

Hoff, R., J. Michel, P. Hensel, E.C. Proffitt, P. Delgado, G. Shigenaka, R. Yender, A.J. Mearns (2014) Oil Spills in Mangroves. Planning and Response Considerations. National Oceanic and Atmospheric Administration. National Ocean Service, Office of Response and Restoration, U.S. Department of Commerce.

Hutchings P. and Saenger P. (1987). Ecology of Mangroves. Brisbane: University of Queensland Press.388pp.

Hutchison, J., Spalding, M. and Ermgassen, Z. P. (2014) The Role of Mangroves in Fisheries Enhancement. The Nature Conservancy and Wetlands International. 54 pages

Instituto Nacional de Pesca INP (2017). Desembarques mensuales de peces pelágicos pequeños-periodos 2004-2017. Desglose del OTROS ,durante 2004-2017. Obtenido de istitutopesca.gob.ec/wp-content/uploads/2018/01/DesembPPP-2004-2017.pdf

Jennerjahn, T. C., and Ittekkot, V. (2002). Relevance of mangroves for the production and deposition of organic matter along tropical continental margins. Naturwissenschaften, 89(1), 23–30. doi:10.1007/s00114-001-0283-x

Krauss K.W., McKee K.L., Lovelock C.E., Cahoon D.R., Saintilan N., Reef, R. and L.Chen (2014). How mangrove forests adjust to rising sea level. New Phytol. 202:19–34

Latorre, S. (2014). Resisting Environmental Dispossession in Ecuador: Whom Does the Political Category of “Ancestral Peoples of the Mangrove Ecosystem” Include and Aim to Empower? Journal of Agrarian Change, n/a–n/a. doi:10.1111/joac.12052

Lopez-Angarita,J., Tilley,A., Diaz, J.M., Hawkinns,J.P., Cagua,E.F. and Roberts,C.M. (2018). Winners and losers in Area-Based Management of a Small-Scale in the Colombian Pacific. Frontiers in Marine Sciences, february 2018, Volume 5 article 23. Doi: 10.3389/fmars.2018.00023

Lugo, A.E. and S.C. Snedaker. 1974. The ecology of mangroves. Annual Review of Ecology and Systematics 5:39-64.

MAE. Ministerio del Ambiente (2017) http://www.ambiente.gob.ec/ proyecto-regularización-de- camaroneras/. Acceso 23 Mayo 2017

McKee K.L., Rogers K., Saintilan N. (2012). Response of salt marsh and mangrove wetlands to changes in atmospheric CO2, climate, and sea level. In Global Change and the Function and Distribution ofWetlands, ed. BA Middleton, pp. 63–96. New York: Springer

MacKenzie, R.A., Foulk, P.B.,Val Klump, J., Weckerly, K., Purbospito, J., Murdiyarso, D., Donato, D.C. and Nam, V.N.(2016).Sedimentation and belowground carbon accumulation rates in mangrove forest that differ in diversity and land use: a tale of two mangroves. Wetlands ecol. Manage. 24: 245-261. DOI 10.1007/sl1273-016-9481-3

Ocampo-Thomason, P. (2006). Mangroves, people and cockles: Impacts of the shrimp-farming industry on mangrove communities in Esmeraldas Province, Ecuador.

In Environment and Livelihoods in Tropical Coastal Zones: Managing Agriculture-Fishery-Aquaculture Conflicts (pp. 140–153). CABI Publishing

Paw, N.J. & Chaw, T.E. (1991). An Assessment of the ecological and economic impact of mangrove conversion in Southeast Asia. Towards an integrated management of tropical coastal resources. ICLARM.Conference Proceedings 22:201-212.

Phan, N.H., J.S.M Van Thiel De Vries and M.J.S. Stive (2015). Coastal mangrove squeeeze in the Mekong Delta. J. Coast. Res 31: 233-43

Robertson, A.I. and Alongi, D. M. (1992). Tropical mangrove ecosystems. American Geographical Union.

Robertson, A. I., and P.A. Daniel (1989). The influence of crabs on litter processing in high intertidal mangrove forests in tropical Australia. Oecologia, 78(2), 191–198. doi:10.1007/bf00377155

Rodríguez F.V.. (2018) Mangrove Concessions: An Innovative Strategy for Community Mangrove Conservation in Ecuador. In: Makowski C., Finkl C. (eds) Threats to Mangrove Forests. Coastal Research Library, vol 25. Springer, Cham

Snedekar, S. C. and Brown, M. S. Water quality and mangrove ecosystem dynamics. EPA Res. Dev. EPA 600/S4, (1981).

Tomlinsom P.B. (1986). The boyany of Mangroves. New York: cambridge University Press

Twilley, R.R. 1989. Impacts of shrimp mariculture practices on the ecology of coastal

Van Lavieren, H., Spalding, M., Alongi, D. M., Kainuma, M., Clüsener-Godt, M., Adeel, Z., and Benedetti, L. (2012). Securing the Future of Mangroves. A Policy Brief to the United Nations - Institute for Water, Environment and Health, *53*. Retrieved from http://www.inweh.unu.edu

Veuthey, S., and Gerber, J.-F. (2012). Accumulation by dispossession in coastal Ecuador: Shrimp farming, local resistance and the gender structure of mobilizations. Global Environmental Change, 22(3), 611–622. doi:10.1016/j.gloenvcha.2011.10.010

Shahbudin, S., MohdLokman, H., Rosnan, Y. and Toshiyuki, A. (1999). Sediment accretion and variability of sedimentological characteristics of a tropical estuarine mangrove: Kemaman, Terengganu, Malaysia. Mangroves and saltmarshes, 3: 51-58.

5. ANNEXES

ANNEX 1. Fishing record sheet sample

ENVIRONMENTAL AND SOCIAL ASSESSMENT, PROJECT PUERTO BOLIVAR – PHASE 1

– ASSESSMENT OF SENSITIVE HABITATS –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Table of Contents

Index of tables

Index of figures

EXECUTIVE SUMMARY

This report presents an inventory and general description of the habitats found in the area of influence of the Puerto Bolivar Project, in order to categorize them as natural or modified areas, and to find critical habitats that require an action plan for their protection. The approach for determining the types of habitats is of a precautionary nature and responds to ecological, socio-cultural and economic criteria linked to the generation of ecosystem services. The different sites were identified and entered into maps.

The natural and modified habitats were geo-referenced after direct observation trajectories by approaching the coastal edge, describing the main activities carried out in their vicinity, as well as rapid ecological evaluations of strategic sectors for environmental assessments.

A description is made of the evolution of land use, in particular, the loss of mangroves to shrimp production, which has been occurring over the last five decades, and which has promoted the protection, by the Ecuadorian state, of the remaining mangrove remnants, mainly on the borders of shrimp farms.

It is estimated that the only critical habitat is the mangrove remnants located in the vicinity of the current Naval and Coast Guard School of the Navy of Ecuador, which are approximately 0.6 ha of mainly dwarf mangroves that could be affected by the expansion of the current pier 6, which in turn would generate a positive effect of increased subtidal biological fouling that would develop on its piles.

At a macro level, it is considered that the greatest risk faced by the area of influence is the unstoppable rise in sea level, a global effect that is not related to the Puerto Bolivar project and that postpones to a second level the potential and diminished effects that could result from activities related to the Puerto Bolivar project.

ASSESSMENT OF SENSITIVE HABITATS

1. Introduction

Performance Standard 1 specifies that all projects with environmental risk and potential impact are subject to a social and environmental assessment process. The types and significance of biodiversity are assessed and the potential impact of project-related activities is considered, taking into account the location and scale of the activities, the proximity of the project to areas of important biodiversity, and the type of technology to be employed. Assessing the significance of project impacts on the suite of biodiversity levels is an integral part of the Environmental and Social Assessment process. The main threats to biodiversity include habitat destruction and invasion of exotic species.

Performance Standard 6, Biodiversity Conservation and Sustainable Management of Natural Resources, describes the objectives of the Convention on Biological Diversity, promoting the use of renewable resources in a sustainable manner, and addresses how threats to biodiversity due to project activity can be avoided or mitigated.

Habitat destruction is recognized as the greatest threat to the preservation of biodiversity. Habitats can be:

- Natural: aquatic and terrestrial areas where the biological communities consist mostly of native plant and animal species and where human activity has not substantially modified the primary ecological functions of the area.
- Modified: areas altered by the introduction of foreign plant and animal species, as in agricultural areas.
- Critical: subset of both natural and modified habitats; determined by the presence of high biodiversity values, including endemic species, at risk of extinction, or habitat that is required for the survival of a species or particular behaviors of these.

In practice, natural and modified habitats exist in a diversity of manifestations. Both may have characteristics that, a priori, could belong to the other, and both are capable of supporting significant biodiversity at all levels, including endemic or threatened species. Thus, identifying an area as natural or modified habitat can be a complex process.

A project may involve a mosaic of habitats, where each will need to be addressed in a manner consistent with the requirements outlined in Performance Standard 6.

2. Habitat types and action plans

Performance Standard 6 recognizes the need to consider impacts on biodiversity of habitats, natural or modified, as modified habitats can have significant biodiversity value, and this is where the private sector develops its projects.

2.1 Modified habitats

Modified habitats may provide suitable living space for many plant and animal species, although the quantity and quality of ecosystems and their species, as well as the ecosystem services they could provide, have been diminished by changes to the original natural habitat.

In his presence, precautions should be taken to minimize any further transformation or deterioration and, depending on the nature and magnitude of the project, identify opportunities to enhance such habitats and protect and conserve biodiversity as part of its operations.

2.2 Natural habitats

In areas of natural habitats, the customer shall not significantly modify or deteriorate such habitats unless the following conditions are met:

- There are no other technically and financially viable alternatives;
- The overall benefits of the project outweigh the costs, including the costs to the environment and biodiversity;
- Any modification or deterioration is appropriately mitigated.

Mitigation measures will be designed to achieve no net loss of biodiversity, where possible, and may include a combination of actions, such as:

- Restoration of habitats after the operation
- Offsetting losses through the creation of a comparable area or areas to be managed for biodiversity purposes.
- Compensation for direct users of biodiversity

2.3 Critical habitats

Critical habitat is a subset of natural and modified habitats that deserves special attention. It meets at least one of the following characteristics:

i) a large number of endemic or restricted-range species are found only in one specific area

ii) the presence of species known to be extremely endangered or at risk of extinction

iii) habitat that is required for the survival of a particular migratory species or to support globally important single gatherings or numbers of individuals of congregatory species

(iv) unique assemblages of species that cannot be found elsewhere

v) areas that are of significant scientific value due to the presence of evolutionary or ecological attributes

vi) areas that include biodiversity that has social, cultural or economic significance of importance to the local communities

vii) areas recognized as being of paramount importance for the protection of ecosystem services (such as aquifer protection)

Projects should be carried out in critical habitat only if it can be demonstrated that they will not have a measurable adverse impact on the ability of the critical habitat to maintain the high biodiversity value. Populations of any species recognized as endangered or critically endangered (according to the IUCN Red List) must not be reduced.

2.4 Legally protected areas

In the event that the proposed project is located in a legally protected area, in addition to the requirements for critical habitats outlined above, it shall comply with the following requirements:

- Act in a manner consistent with the management plans of the defined protected areas.
- Consult on the proposed project with protected area managers or sponsors, local communities and other key stakeholders.
- Carry out other programs, as appropriate, to promote and enhance the conservation objectives of the protected area.

Ensure that project activities are consistent with any national land use or management criteria, resource uses and management criteria (including Protected Area Management Plans, National Biodiversity Action Plans or similar documents).

2.5 2.5 Invasive or Foreign Species

An foreign species is one that is introduced beyond its original range. Invasive foreign species are species that can become invasive or spread rapidly in competition with other native plants and animals when introduced into a new habitat that lacks their traditional controlling factors. Invasive foreign species are recognized as a major threat to biodiversity worldwide.

The intentional or accidental introduction of exotic or non-native species of flora and fauna into areas where they are not normally found can constitute a significant threat to biodiversity, as some foreign species can become invasive, spreading rapidly and overtaking native species.

The project shall ensure that it does not intentionally introduce new foreign species unless it does so in accordance with the existing regulatory framework for such introduction, if any, or undergoes risk assessment (as part of the project's Social and Environmental Assessment) to determine potential invasive behavior. Shall not intentionally introduce any alien species with a high risk of invasive behavior or any recognized invasive species, and shall use its best efforts to avoid any accidental or unintentional introductions.

3. Methodology

Yilport project Phase 1 is being developed in a coastal marine ecosystem. To diagnose the characteristics of the area's habitats and direct influence on this ecosystem, a bibliographic research of the historical changes in land use in the area of influence, with emphasis on the coastal marine edge, was carried out.

Then, an in situ identification was carried out by means of coastal navigation in a 7.5 m fiber boat propelled by two outboard motors (Yamaha 75 Hp and Suzuki 90 H), setting sail from the Puerto Bolivar coastal dock between October 30 and November 3 of this year, supported by a map of the main sectors that served as an initial reference.

In some sectors it was necessary to disembark to verify aspects that attracted attention, scanning the coasts while navigating parallel to it with the use of Buschnell Binoculars, to observe details of those sectors that could not be accessed due to low tide limitations or for safety reasons. UTM coordinates (WGS84) were taken at all sites with a Garmin Etrex 400 GPS and the coordinates that could not be taken in situ were taken in the body of water to be subsequently transferred to the coastal profile, when building the corrected map of sensitive sectors and infrastructure by a GIS specialist.

After the inventory, we proceeded to estimate the potential loss of habitats that could be attributed exclusively to the Puerto Bolivar project, estimating the potential affected area that should be observed during and after the construction phase of the expansion to the north of Pier 6.

For each habitat and sensitive site, general aspects of the site were recorded on cards with photographic support, which are attached to this report.

Table 1 shows the criteria for categorizing the identified sectors, sites and infrastructure.

Table 1. Categorization of sensitive areas, sites and infrastructure in the area of influence of the project.

Code	Description	Relevance
PAP	Pedestrian artisanal fishing	Ecosystem service of socioeconomic importance
PACM	Artisanal motorized coastal fishing	Ecosystem service of socioeconomic importance
PAF	Artisanal fishing with fixed gear	Ecosystem service of socioeconomic importance
DCC	Shrimp dams	Ecosystem service of socioeconomic importance
MGI	Internal mangroves	Ecological/ Socioeconomic
MGC	Coastal mangroves	Ecological/ Socioeconomic
BOC	Mouths or outlets of estuaries	Ecological
ESC	Breakwaters or protective rockfaces	Ecological/ Social
BAJ	sandy shallows, shells, muds that emerge at low tide	Ecological/ Social
WITH	Shells or empty shells aggregation beaches	Ecological/ Social
PAJ	Bird aggregation sites	Ecological
TUR	Sectors with tourist exploitation	Ecosystem service of socioeconomic importance

Prepared by: Ecosambito, 2020

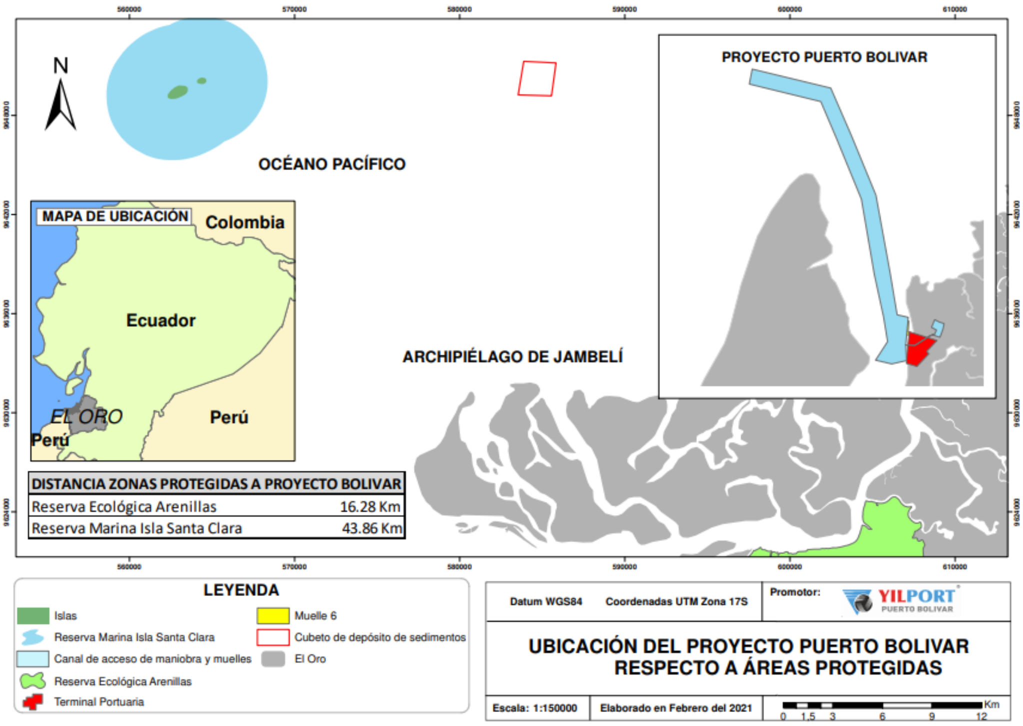
4. Results

4.1 Legally protected areas

The Certificate of Intersection of the project with the National System of Protected Areas (SNAP), State Forest Heritage (PFE) Forests and Protective Vegetation (BVP), showed that it DOES NOT INTERSECT with any category of areas protected by the Ecuadorian State.

The following map shows the relationship of the project's location with respect to the protected areas closest to the project.

Figure 11Protected areas in the vicinity of the project



Prepared by: Ecosambito, 2020

As can be seen in the image, the Santa Clara Island Marine Reserve is located 43.86 km from the dredging sediment dump area, while the Arenillas Ecological Reserve is located 16 km south of the Port Terminal. All port terminal activities are carried out towards the northern sector of the terminal, and there is no possibility of interaction with the Arenillas Reserve. Something similar happens with Santa Clara Island, since dredging activities are carried out to the east, while the island and its marine area are located to the west.

Santa Clara Island Marine Reserve. It is located at the entrance of the Gulf of Guayaquil, about 43 kilometers west of Puerto Bolivar, and about 25 kilometers southwest of Puná Island, belonging to the province of El Oro. It was declared a protected area on March 6, 1999, according to Ministerial Agreement A-83, through Official Register No. 219 of June 24, 1999. For the conservation of oceanic islands that are highly vulnerable to erosive anthropogenic activities and the protection of their species. The protected area includes Santa Clara Island, the surrounding islets and two nautical miles around it. Its ecosystem is made up of rocky reefs, wetlands, and a marine-coastal transitional ecosystem where the main currents and cold water masses converge. It has terrestrial-coastal, marine and aerial habitats. Among the endemic species are frigate birds, Fregata magnificens, brown pelicans, Pelecanus occidentali and blue-footed boobies, Sula nebouxii, among others.

Arenillas Ecological Reserve. It is located in southwestern Ecuador, in the province of El Oro, near the border with Peru, between the towns of Arenillas and Huaquillas. It covers more than 17,000 ha. The Arenillas Ecological Reserve was declared a protected area more than 60 years ago, but was officially recognized in 2001. It was declared a protected area for the conservation of its ecosystems and habitats of endangered species. The reserve has been included in Ecuador's National System of Protected Areas since June 2001. The reserve includes forest and dry scrub ecosystems of southwestern Ecuador, although commercial timber trees have already been extracted. It is dominated by lowland deciduous forest and tropical dry scrub. The vegetation becomes shrubbier as you get closer to the coast, where there are 2,800 ha of mangroves. There are about 153 bird species, 35% of which are endemic. The reserve contains the following endangered birds: Macareño parakeet (Brotogeris pyrrhoptera), Anambé Pizarra (Pachyramphus spodiurus) and Black-headed Curassow (Synallaxis tithys). Arenillas is an important site for Tumbesian endemic species. The mangrove areas are an important aggregation site for resident and migratory congregatory species.

4.1.1 National legal protection in favor of mangrove ecosystem.

Due to the accelerated expansion of shrimp farming and the dangerous decline of the mangrove ecosystem, Law No. 91, Official Registry No. 495 of August 7, 1990, incorporates mangrove forests into the State Forest Patrimony.

Article 769 of the Regulations to the Organic Environmental Code of Ecuador declares the mangrove swamp as an "Important Ecosystem".

> *"In the coastal area, mangroves and other coastal wetlands, as well as the natural remnants of dry forest found in watersheds with coastal frontage, will be considered as ecosystems of importance for the conservation and management of biodiversity."*

For its management and sustainable use, it states in Article 265 that "*The agreements for sustainable use and custody of the mangrove ecosystem constitute a mechanism for conservation, granted by the National Environmental Authority. These agreements may be granted and awarded to mangrove users who carry out traditional activities permitted within the mangrove".*

The possible modification of this ecosystem will be granted exceptionally by means of a motivated resolution (art. 278), and may include cutting or pruning the mangrove, as well as productive activities that require permanent maintenance for navigation, risk prevention, opening of transit easements, docks or port works.

Such resolution may be issued once the proponent has obtained the corresponding environmental administrative authorization, and shall contain:

a) The determination of the area of restoration and compensation of mangrove cover, depending on the type of project, in a mangrove ratio of 6 to 1 for each hectare cleared in the totality of the project, in the areas of restoration prioritization defined by the National Environmental Authority, who will approve the areas where the compensation of mangrove cover will be carried out; and,

b) Proof of payment for monetary compensation, equivalent to the total costs of restoration of the affected area.

4.2 Inventory of sites of interest and identification of main habitats

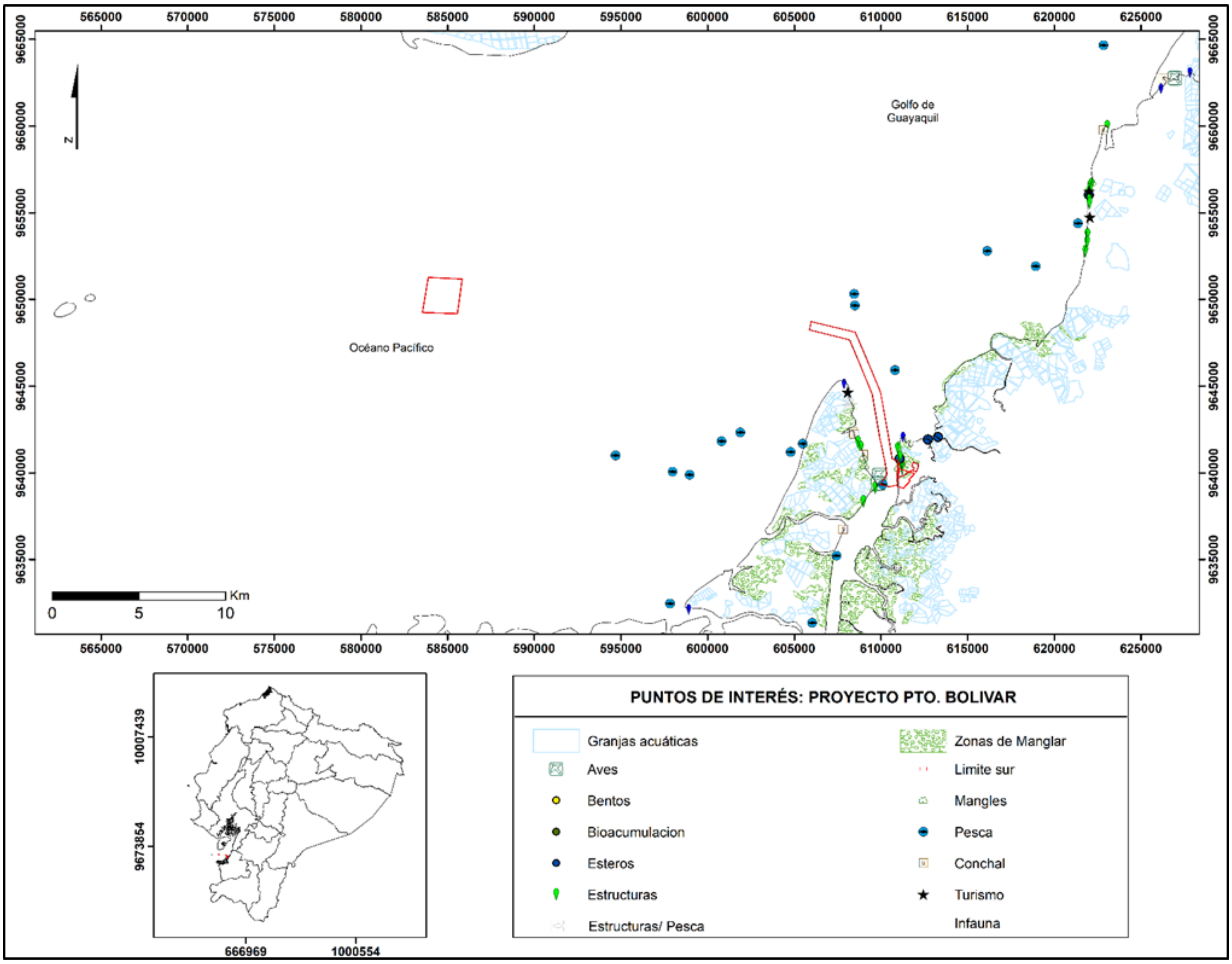
Table 2. Sites inventoried in routes parallel to the coastline

Type of record	Code	Site / legend	X	Y
Infauna	TUR1	Jambelí Beach	9645120	607858
Infauna	PAP1	Love Island Beach	9642172	610724
Fishing	PACM1	Shrimp fishing	9642332	601881
Fishing	PACM2	Shrimp fishing	9641826	600801
Fishing	PACM2	Shrimp fishing	9641010	594685
Fishing	PACM3	Shrimp fishing	9639886	598957
Fishing	PACM4	Shrimp fishing	9640066	597977
Fishing	PACM5	Shrimp fishing	9641202	604788
Fishing	PACM6	Shrimp fishing	9641688	605485
Mangrove	MGC1	Yilport 1	9640272	611029
Structures	ESC1	Heliport	9640374	611044
Structures	ESC2	Liceo Naval	9640424	611022
Mangrove	MGC2	Yilport2	9640510	611058
Mangrove	MGC3	Yilport3	9640624	611065
Structures	ESC3	Enrocado	9640624	611045
Mangrove	MGC 4	Yilport4	9640754	611044
Estero	BOC1/ESC5	The Dead	9640818	610988
Structures	ESC4	Shrimp wall 1a	9640904	610978
Structures	ESC4	Cam1b rockfill wall	9641424	610838
Estero	BOC2	Water Outlet Love Island Beach	9643268	610744
Estero	BOC3	Blind estuary	9644832	611507
Multipurpose	TUR2	Coco Beach		
Fishing	PAF2	Handbags 1	9652794	616128
Fishing	PAF2	Handbags 2	9664704	623081
Birds	PAJ1	Pajarada1	9664636	623194
Infauna	BAJ1 PAJ2	La Puntilla Islet	9663698	623495
Infauna	BAJ2 PAP2	La Puntilla	9662266	623542
Beach	TUR4	Playa de Arena home	9662868	622490
Structures	ESC 5	Beach Ruin	9660654	622619
Beach	TUR4	Sand beach end	9660180	622610
Mangrove	MGC5	Dead Mangrove	9656776	621926
Structures	ESC6	Breakwater #1	9656664	621910
Structures	ESC7	Breakwater #2	9656514	621895
Structures	ESC 8	Breakwater #3	9656368	621912
Tourism	TUR3	Balneario Bajo Alto	9656246	621944
Structures	ESC9	Breakwater #4	9656154	621966

Type of record	Code	Site / legend	X	Y
Esteros	BOC4	Estero Bajo Alto	9656036	621994
Structure	ESC10	Shrimp wall	9655846	622000
Structures	ESC11	Petroamazonas wall start	9655562	622023
Tourism	ESC11	Petroamazonas Wall End	9654726	621560
Fishing	PAF3	Handbags 3	9654392	621367
Structures	ESC12	Shrimp wall	9653796	620762
Structures	ESC13	Shrimp wall	9653346	620448
Structures	ESC14	Shrimp wall	9652886	620095
Fishing	PAF 4	Caletera network 1	9651916	618927
Fishing	PAF 5	Caletera network 2	9639978	609762
Tourism	TUR 4	La Playita Pier	9644642	608379
Structures/ Fishing	ESC 15	Shrimp and Tape Wall 3	9644204	608548
Structures/ Fishing	ESC15	Shrimp and Tape Wall 4	9643698	608674
Beach	CON1	Conchal #1	9642540	608990
Beach	CON2	Conchal #2	9642226	609065
Structures	ESC16	Shrimp wall	9641798	609219
Structure	ESC17	Shrimp wall	9641480	609345
Structures	CON3	Conchal #3	9641038	609517
Mangrove	MGC6	Dead mangrove / shrimp farm	9640832	609601
Mangrove	MGC7	Dead mangrove end / shrimp farm	9640388	609778
Birds	PAJ3	Pajarada2	9639866	609894
Birds	PAJ4	Nesting Frigates	9639380	609840
Structures	ESC 18	Shrimp wall	9639140	609710
Structures	ESC19	Shrimp wall	9638346	609160
Beach	CON4	Conchal 4	9636766	608015
Fishing	PACM7	Guajabal Cove	9635226	607428
South boundary		Pongal Estuary	9630994	606800
Fishing	PACM8	Mangrove fishing	9631356	606029
Infauna	BOC5	Pongalillo Beach	9632120	598897
Fishing	PACM 8	Fishing	9632466	597828
Fishing	PACM9	Shrimp fishing	9649650	608497
Fishing	PACM10	Shrimp fishing	9650320	608444
Fishing	PACM 11	Artisanal bowling	9645930	610805
Fishing	PACM12	Inland fishing	9639322	610102

Prepared by: Ecosambito, 2020

Figure 2. Identification of points of interest in the marine-coastal area, according to observation tours.



Prepared by: Ecosambito, 2020

From the above description, the following habitats are found along the coastal edge of the area of influence:

- mangroves
- sand and mud beaches
- aquaculture infrastructures, for fishing facilities and shoreline protection

Table 3. Identification of main habitats.

Ecosystem	Description	Habitats		
		Natural	Modified	Possibly Critic
Mangroves	Mangroves are a characteristic type of coastal wetland that develops in tropical and subtropical intertidal zones and are made up of facultative tree formations or dense halophytic plants (Ball and Farquhar, 1984). They have in common a wide variety of morphological, physiological and	X	X	X

Ecosystem	Description	Habitats		
		Natural	Modified	Possibly Critic
	reproductive adaptations that allow them to inhabit extreme environments with unstable substrate, high organic matter content, high temperatures, large salinity fluctuations and low oxygen concentrations (Tomlinsom 1986, Hutchings and Saenger, 1987). In Ecuador, all mangroves are considered, in its legislation, as State Forest Heritage, and their logging is totally prohibited, under penalty of significant economic fines and mandatory remediation. In addition, the state promotes the sustainable use of the fishery resources that grow under the shelter of this ecosystem through Sustainable Use and Mangrove Custody Agreements (AUSCM), which over the years have become an important source of socioeconomic development for the ancestral user communities of these resources.			
Sand/sludge/shell beaches	They are intertidal flooding sectors of low slope where the accumulation of sediments of mineral or biological origin and even human waste occurs, the length of these beaches is variable as they can be from less than 100 meters to kilometers long. Most of the sandy beaches present in the area of influence are considered dissipative based on their gentle slope and the presence of fine sands and muds, with wide intertidal ranges (Defeo,2018). The width of the intertidal fringe of exposed beaches of Jambelí Island is less than those observed in exposed beaches of the Jambelí channel and internal beaches of Estero Santa Rosa. The muddy beaches inside Estero Santa Rosa harbor important populations of infauna and particularly of bivalve mollusks, mainly two types of clams, mussels and zangaras, both for local consumption and for commercialization, as these fisheries are not regulated.	X	X	
Piers and artificial coastal structures	In this category you will find: - Port infrastructure of the Puerto Bolivar project - Minor docks mainly in the Huaylá estuary - Wooden jetties and various types of coastal protection known as breakwaters, which can be located directly on the coastal edge or, as in the case of two seaside resorts, parallel to the coastal edge but distanced from beaches, as well as perpendicular to beaches in order to reduce the movement of water and reduce the erosive effect of the sea on them. Solid infrastructures such as rockfill or concrete structures, in addition to stabilizing the coastal edge, generate a positive effect on the environment by providing solid substrates for the settlement and development of a greater number of marine invertebrates, whether encrusting or populations of other invertebrates and fish that find refuge among them, increasing the diversity of species with respect to soft-bottom sediments, In this way, a positive effect is expected with the extension of the current pier 6 of the Puerto Bolivar project, since it		X	

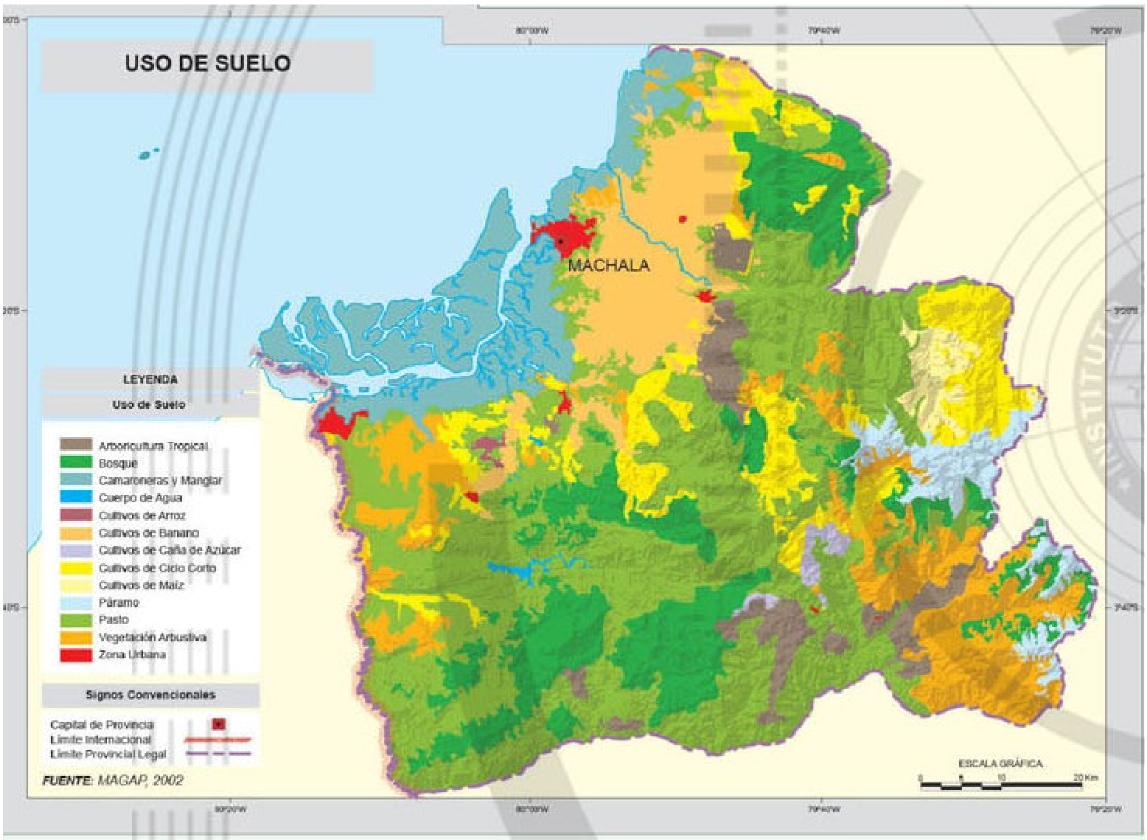
Ecosystem	Description	Habitats		
		Natural	Modified	Possibly Critic
	would increase populations of encrusting invertebrates and fish in the area, since these are sectors with restricted access where fishing activities are not practiced, serving as small local reserves.			
Shrimp farming facilities	This is a specific modification designed to contain water in extensive shallow pools to which water is pumped from the environment with high tides by suction pumps, the water contained in these pools is fertilized and shrimp larvae are added for production, which must be fed, in addition to requiring a daily partial water replacement to increase the natural food intake and decrease the accumulation of organic pollutants in the water column. Shrimp farm effluents or outflows are characterized by a high degree of organic enrichment and decrease planktonic and benthic diversity. These facilities are the majority in terms of coastal area used and are shown with light blue boxes as "aquatic farms" on the map in Figure 4.		X	

Prepared by: Ecosambito, 2020

4.3 Description and historical transformation of habitats in the project area.

The magnitude of land use change or degree of habitat transformation along El Oro's coastline is a controversial issue in the province, whose land use map is shown in Figure 3. The map does not distinguish between shrimp farms and mangroves, after which comes a strip of permanent crops and pastureland extending to the foothills of the mountains, and the main population centers are shown in red. Practically the entire coastal plain has been altered for decades.

Figure 3. Map of land use in the province of El Oro.

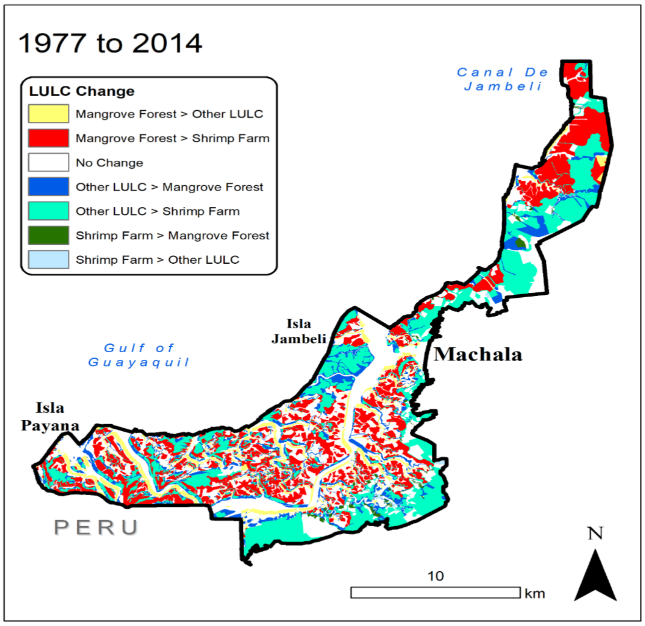


Source: Instituto Geográfico Militar del Ecuador, taken from www.geoportaligm.gob.ec

More than half of the territory shown as shrimp and mangrove farms was transformed from mangroves to shrimp farms in the last 43 years. Although no recent publicly available studies are available, the magnitude of this transformation is evident in the period 1977 to 2014 shown in Figure 4 and taken from Hamilton (2020).

As can be seen, the mangroves present in the area of influence of the project correspond to remnants of major forests cut down since the mid 1970s, leaving in most of the coastal sectors, small "patches" of mangrove forests that appear in blue, remnants bordering saturated sectors of shrimp ponds that appear in turquoise and red.

Figure 4. Change in land use in the province of El Oro



Source: Hamilton, 2019

In turn, these remnants show different conditions, including the loss of tall mangroves towards the northern coastal edge of the town of Bajo Alto, where the first strip of red mangroves of a few kilometers is already lost, and a forest of dead trunks can be observed. At the end of this strip of mangroves there is an extensive sandy beach with ruins of structures that have been devastated by the rising sea level.

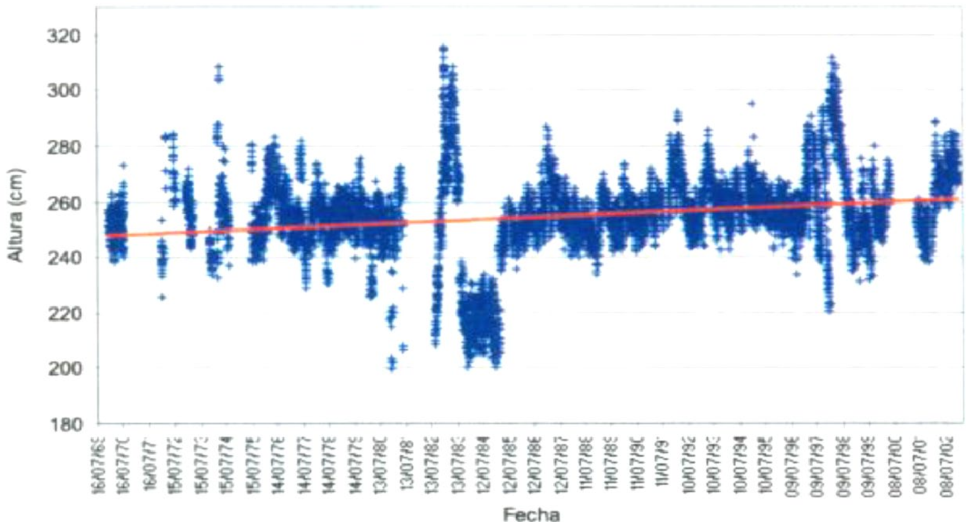
At this point, it is important to mention that the greatest agent of coastal transformation is the rise of the sea along the coastline of the province of El Oro, a situation that is evidenced by the construction of numerous rocky protections (breakwaters) that seek to protect certain sectors. These structures are common in shrimp farm walls in the Jambelí archipelago. Likewise, in places of tourist importance such as Bajo Alto and Playa Jambelí, where the state has had to invest millions of dollars to protect beaches.

In order to dimension this problem, a study on the evolution of sea level from 1970 to 2002 by Leonor Vera (2003), where corrected data from the mean sea level (MSL) of the Puerto Bolivar tide gauge station was analyzed, shows the rising trend shown in Figure 5. The author determined that in the study period (32 years), the sea level had risen 16 cm or 0.5 cm/year. Without adjusting any calculation and maintaining this trend, the sea level would have risen 8 cm more until today, surpassing the local sea level rise to the world average estimated between 21 to 24 cm from 1880 to 2009 (Lindsey, 2009).

To the south of Bajo Alto, reaching Playa Coco, the mangroves are of medium size and are interrupted by numerous reinforcement structures, mainly rockfill that serve as protection for shrimp pool walls and closer to the town of Bajo Alto, the protection structures of the gas pipeline from the Amistad Platform that connects to the Machala Power electricity generator.

Within the Santa Rosa estuary different mangrove conditions are observed, but in general terms larger trees are observed as you move away from Puerto Bolivar south to the Pongal estuary, however, in front of the seawall of Puerto Bolivar two sectors of significant seabird activity were identified: An aggregation of Frigatebirds and Cormorants, while to the north an important aggregation of wading birds was observed in the sector of La Puntilla; at this point the sectors called Bajeríos become important, which correspond to sectors of rest and feeding of birds with low tides forming an extensive strip of shallow depth between Bajo Alto to El Coco beach.

Figure 5. Sea Level Rise at Puerto Bolivar 1970-2002



Source: INOCAR, 2004.

The muddy and mixed-bottom beaches present in the Santa Rosa estuary are important for fishing and ecology, they concentrate an important infauna that is exploited by residents of Puerto Bolivar and Machala, and although when reviewing other beaches such as the internal sector of La Puntilla and Pongal beach where the presence of several edible species was evidenced, these are not exploited to the level observed in Isla del Amor and on the inner margin of Jambelí Island where daily exploitation of clams occurs.

Motorized coastal artisanal fishing is carried out practically throughout the entire area of direct and indirect influence of the Puerto Bolívar project[1], and if the observation routes had been extended to the southwestern margin of Puna Island, the northern continental margin passing the mouth of La Puntilla or southward through the Jambelí archipelago, or to the west, if they had sailed to Santa Clara Island, the same situation would have been observed. The entire coastline and inland waters are routinely fished.

During bimonthly monitoring conducted in the last two years in the dredge basin sector, in all samples, small vessels were observed fishing, as well as the transit of small and industrial vessels heading to Santa Clara.

Although all coastal water is exploited, according to the testimony of fishermen interviewed during fishing operations, they mentioned that fishing grounds vary according to the season and the change in natural supply in major sectors and that within major sectors there are

[1] The Ecosystem Services report elaborates on this activity by elaborating on the provision of goods

several sites (fishing grounds) that are systematically checked. Generally speaking, when a fisherman has a good catch in a specific fishing ground, that fishing ground is exploited for 2-3 days until its productivity declines and another fishing ground is tried. However, there is a sectorization with respect to distance from the coast: the shrimp fishery is coastal, in shallow sectors associated mainly with outlets of bodies of water or mouths that flow into the Jambelí Channel, and passive gear such as bags are installed in the vicinity of these.

Some fish have main fishing grounds with specific dates such as the bet to exploit large corvina, these, although they are captured in coastal and inland bodies of water, the largest pieces are achieved in the Jambelí channel taking advantage of their migration towards inland waters of the Guayas system. In deeper sectors and farther from the coast, larger fish are caught in riskier and more expensive operations.

4.4 Invasive species

One way in which marine transportation can impact the biodiversity of the area where it operates is the unintentional transfer of invasive species through ballast water that the ship takes on board in one port and then discharges in another to compensate for the loss or increase in weight due to the loading or unloading of goods. This water can bring marine species such as bacteria, viruses, protozoa, phytoplankton and some macroscopic species, and can include human pathogens. Another way of transporting invasive species can be through fouling on the hulls of ships.

The diversity of organisms that can survive in a new aquatic environment is limited. For a species transported in ballast water to be successful, the following factors play a role: water temperature range and time in which the temperature is favorable, tolerance to salinity, suitable ecological conditions (habitat, predators, food sources).

Although equatorial zones, are not classified as Potentially Hazardous Zones (Baro & Stotz, 2018), there are actions that can be executed to reduce the risk of invasion of alien species, such as: 1) Verification of Compliance with the Ballast Water Report, 2) Verification of the ballast water source zone, 3) quantify the risk associated with ballast water discharge and ballast water replacement check, in case risk factors are identified.

5. Critical habitats

Puerto Bolivar Phase 1 project will basically influence marine-coastal habitats, with practically no influence on terrestrial ecosystems, hence the fact that the Critical Habitats analysis focuses on these ecosystems.

Critical habitats are areas of high biodiversity value that include at least one or more of the five values specified in paragraph 16 of Performance Standard 6 or other recognized high biodiversity values. From the analysis in Critical Habitats, the following results are obtained.

Table 4. Results of the Critical Habitat analysis.

NO.	CRITERIA	RESULTS	COMPLIANCE WITH CRITERIA
1	Endangered (EN) or Critically Endangered (CR) Species	Although there are insufficient data to determine compliance with thresholds for these criteria, species with CR and EN status were determined: 3 species of birds, 16 of fish, 1 of invertebrates and 1 of reptiles, in marine-coastal ecosystems.	NO
	Endemic or geographically restricted species	The coastal marine ecosystems in the study area belong to the Tumbes-Chocó-Magdalena eco-region, which covers 1500 km of coastline (greater than 500 km of linear geographic extension considered as a threshold for coastal species).	NO
	Migratory species or species forming congregations	Migratory species: Mantas, sharks, and humpback whale Megaptera novangliae were identified. Congregations in mangroves: Because of their role as *nurseys* for aquatic species Congregations: Santa Clara Island involves the largest congregation of seabirds and pinnipeds in the area.	YES
	Highly threatened or unique ecosystems	The mangrove ecosystem and marine ecosystem, including Santa Clara Island, are identified as highly threatened ecosystems.	YES
5	Key evolutionary processes	The mangrove ecosystem presents evolutionary processes, due to its contribution to climate change adaptation, thanks to its capacity to achieve sedimentation and coastal stabilization.	NO

Prepared by: Ecosambito, 2020

Therefore, the presence of critical habitats is determined in the area of direct and indirect influence of the project, consisting of the mangrove and marine ecosystem, including the Santa Clara Island Marine Reserve.

6. Conclusions

The area where the Puerto Bolívar project is being developed is an area that has undergone major transformations in its ecosystems over the last five decades. Although most of the habitats in the vicinity of the project have been modified, they still retain ecological or socioeconomic importance.

Although there are critical habitats in the area of influence of the Puerto Bolívar Port Terminal, the area where the project is located has been in operation for 60 years, while the expansion area has been completely disturbed. The closest mangrove area is the Jambelí archipelago, on the other side of the Santa Rosa Channel, 2 km from the Port Terminal. Although this ecosystem will not be threatened by the expansion project, it is extremely important, due to its biodiversity value, that mechanisms be implemented to promote its conservation.

Regarding the marine area, the area around Santa Clara Island is located in the limits of the area of indirect influence, and could have interaction with maritime traffic; however, port traffic would not represent the greatest threat to this ecosystem, whose greatest pressure comes from fishing activities.

7. Bibliography

Ball, M.C. and Farquhar C (1984). Photosynthetic and stomatal responses of the grey mangrove, *Avicennia marina*, to transient salinity conditions. Plant Physiology 74: 7-11 pp.

Baro-Narbona, Sandra, & Stotz, Wolfgang. (2018). Proposal for ballast water control in ships arriving at ports in the Central Chile Marine Ecoregion. Journal of Marine Biology and Oceanography, 53(3), 291-306. https://dx.doi.org/10.22370/rbmo.2018.53.3.1355.

Defeo Omar (2018). Ecology of sandy beaches: trends and perspectives. Facultad de ciencias, Unidad de ciencias del Mar, Universidad de la Republica del Uruguay. http://jornadasdelmar2018.exactas.uba.ar/wp-content/uploads/2018/08/Defeo_XJNCM_2018.pdf

Hamilton, S.E. (2019). Mangroves and Aquaculture. A five decade remote sensing Analysis of Ecuador's Estuarine Environments. Coastal Research Library 33. ISBN 978-3-030-22240-6. https://www.springer.com/gp/book/9783030222390. https://www.springer.com/gp/book/9783030222390

Hutchings P. and Saenger P. (1987). Ecology of Mangroves. Brisbane: University of Queensland Press.388pp.

Lindsey R. (2009). Sea level since 1880. Climate Change: Global sea level. Climate.gov. science & information for a climate-smart nation. https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level

Tomlinsom P.B. (1986). The boyany of Mangroves. New York: Cambridge University Press.

Vera Leonor (2004). Study of the mean sea level in Puerto Bolivar. Acta oceanografica del Pacifico Vol. 12(1), 2003-2004.

8. Annexes

ANNEX 1. Sensitive Habitats Identification Sheets

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PUERTO BOLÍVAR PROJECT – STAGE 1

– CRITICAL HABITATS –

Prepared for:

[Yilport Puerto Bolívar logo composite mark]

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

[Sambito logo composite mark]

ECOSAMBITO C.LTDA.

December 2020

Table of contents

Table index

Figure index

Photographic records index

ACRONYMS

AAEA	Ecologically Appropriate Area of Analysis
APPB	Puerto Bolívar Port Authority
CMS	Convention on the Conservation of Migratory Species
CR	Critically Endangered
DAC	Qualitative Environmental Diagnosis
DD	Data Deficient
DMU	Discrete management unit
EN	Endangered
ESIA	Environmental and Social Impact Assessment (EIAS by its Spanish acronym)
GN	Guidance Note (NO by its Spanish acronym)
ICF	Forestry Conservation Institute
IUCN	International Union for Conservation of Nature (UICN by its Spanish acronym)
IBAs	Important Bird and Biodiversity Areas
IBAT	Integrated Biodiversity Assessment Tool
KBA	Key Biodiversity Area
LC	Least Concern
MAAE	Ministry of Environment and Water of Ecuador
MLWS	Mean Low Water Springs
MIF	Multilateral Investment Fund
NE	Not Evaluated
NT	Near Threatened
RMISC	Isla Santa Clara Marine Reserve
RVS	Wildlife Refuge
SNAP	National System of Protected Areas
UNESCO	United Nations Educational, Scientific and Cultural Organization
VU	Vulnerable

EXECUTIVE SUMMARY

This report presents the Critical Habitat assessment within the area of influence of Puerto Bolívar project according to the definition of these types of habitats established in Performance Standard 6 of the International Finance Corporation (IFC) that regards them as "areas with high levels of biodiversity, such as i) habitats of major significance to the survival of endangered or critically endangered species; ii) habitats of major significance to the survival of endemic or restricted-range species; iii) habitats that sustain the survival of significant world concentrations of migratory or congregatory species; iv) unique or highly endangered ecosystems, or v) areas associated with key evolutionary processes". This conceptualization is achieved through 5 assessment criteria with their corresponding selection thresholds, which have been used in the performed assessment.

In addition to the information gathered from biotic monitoring and tracking procedures conducted throughout two years in the project area of influence, supporting information has been used in the form of an Integrated Biodiversity Assessment Tool (IBAT) database report specifically on Puerto Bolívar project area; a sighting occurrence report from the *Global Biodiversity Information Facility* (GBIF), together with an extensive bibliographical research.

The analysis shows that Critical Habitats do exist in the area of influence according to 3 of the 5 criteria established by IFC, Criterion 2 (Endemic or restricted-range species), Criterion 3 (Migratory or congregatory species) and Criterion 4 (Unique or highly endangered ecosystems), namely: Archipiélago Jambelí due to its mangrove ecosystem and Isla Santa Clara Marine Reserve (RMISC).

Although there is no doubt that the Project activities will not directly affect these habitats, they may suffer from some indirect effect given their vulnerable condition. Therefore, in agreement with the provisions in IFC Guidance notes of Performance Standard (ND by its Spanish acronym) 6, a portfolio of initiatives has been designed which constitute the Critical Habitats Management Plan whose aim is to achieve tangible benefits associated with the aim of preserving of these habitats.

CRITICAL HABITATS

1. Introduction

Performance Standard 6 acknowledges that the protection and conservation of biodiversity, the maintenance of environmental services and the sustainable management of live natural resources are essential to sustainable development. The requirements laid down in this ND are based on the Convention on Biological Diversity that defines biodiversity as “the variability of live organisms from any source, including, but not limited to, land and marine ecosystems as well as other aquatic ecosystems and the ecological systems they are a part of; it includes diversity within each species, between species and of ecosystems.

The applicability of said Performance Standard is defined during the identification of environmental and social risks and impacts, whereas the fulfillment of the necessary actions in order to meet the requirements herein set forth is managed via the client’s social and environmental management system, whose elements are explained in Performance Standard 1.

The identification of environmental and social risks and impacts will take into consideration the endangerment of biodiversity and environmental services, while strongly emphasizing habitat destruction, decline and fragmentation, invasive exotic species, overexploitation, changes in hydrology and nutrient pollution and contamination. It will also consider the different values that affected communities and, where appropriate, other social actors ascribe to biodiversity and ecological services.

2. Methodology

Critical habitats are areas with high levels of biodiversity, such as habitats of major significance to the survival of endangered or critically endangered species; habitats of major significance to the survival of endemic or restricted-range species; habitats that sustain the survival of significant world concentrations of migratory or congregatory species; unique or highly endangered ecosystems, or areas associated with key evolutionary processes.

2.1 Criteria for defining critical habitats

Critical habitats are areas of high biodiversity levels. ND6 establishes 5 criteria on which any critical habitat assessment must be based:

• Criterion 1: Endangered (EN) or critically endangered (CR) species
• Criterion 2: Endemic or restricted-range species
• Criterion 3: Migratory or congregatory species
• Criterion 4: Unique or highly endangered ecosystems
• Criterion 5: Key evolutionary processes

Numerical thresholds are defined for the first four criteria for decision-making purposes, whose source is the IUCN, a global standard for identifying key biodiversity areas and red list categories and criteria. Thresholds are indicative and merely serve orientation purposes for decision-making. There is no standard formula for defining a critical habitat; the involvement of outside experts and the performance of project-specific assessments is highly important, particularly when data are limited.

There are no numerical thresholds for Criterion 5. Instead, the best scientific information available must be used, as well as expert opinions, in order to guide decision-making with regard to the critical importance of a habitat in these situations.

Table 1. Criterion and thresholds for defining Critical Habitats

	Criterion	Thresholds
1	Endangered (EN) or Critically Endangered (CR) species	a) areas that keep heavy world concentrations of a species appearing in IUCN Red List as CR or EN (≥ 0,5% of world population and ≥ 5 reproductive units of a CR or EN species)
		b) areas that keep heavy world concentrations of a species identified as Vulnerable (VU) in IUCN Red List, whose loss would lead to a change in the Red List species status to CR or EN and which would reach the thresholds of item NO72a);
		c) where appropriate, areas containing large concentrations of a species listed as CR or EN at a national or regional level.
2	Endemic or restricted-range species	a) areas that typically contain ≥ 10% of world population and ≥ 10 reproductive units of a species. • For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO of less than 50,000 km². • For marine systems, restricted-range species are provisionally being regarded as those with an EOO (extent of occurrence) of less than 100,000 km^2. • For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km wide at any point (for example, rivers), restricted-range species are defined as those having a global distribution of less than or equal to 500 km linear geographic span (i.e. the furthest distance between two occupied locations).
3	Migratory or congregatory species	a) areas that cyclically or regularly keep ≥ 1% of the world population of a migratory species or one that congregates at any point in the species life cycle;
		b) areas that predictably sustain ≥ 10% of a species world population during periods of environmental stress.
4	Unique or highly endangered ecosystems	a) areas representing ≥ 5% of the world expanse of a type of ecosystem that fulfills UICN CR or EN condition criteria;
		b) other areas still not assessed by IUCN but which are considered of high conservation priority in regional or national systematic conservation planning.

	Criterion	Thresholds
5	Evolutionary processes of key importance	There are no thresholds; assessment elements will depend on each case.

Prepared by: Ecosambito, 2020

Projects located within a nationally or internationally recognized area of high biodiversity value may require a critical habitat assessment, for example:

- areas that fulfill the criteria for UICN categories of protected areas I.a, I.b. and II;
- key biodiversity areas (KBAs), which include important bird conservation areas (IBAs).

In accordance with the mitigation and management requirements of Performance Standard 6, projects in some areas are not considered suitable for financing, with a few exceptions. This group includes the following areas:

- natural and mixed sites declared World Heritage by UNESCO;
- sites that fulfill the Alliance for Zero Extinction (AZE) designation criteria

2.2 Data collection

The assessment of critical habitats was aided by the collection of secondary information data which will be compared against the IBAT tool (www.ibat-alliance.org), whose report, with a 50 km buffer of Puerto Bolívar project, is shown in ANNEX 1. IBAT reports provide biodiversity database information (protected areas, essential for biodiversity and species) from global databases, hence they can store rather general information of the studied areas; therefore, monitored and/or spotted species within the area of influence are included in the species assessment as part of the regular bimonthly biotic monitoring procedures conducted between 2018 and 2020, in addition to the samplings carried out with the aim of complementing biodiversity and tracking analysis of traditional fisheries developed in November 2020; whose list is shown in Annex 11. List of identified species in Puerto Bolívar area of influence. Lastly, the IBAT database was checked against databases that are updated at a national level, such as BioWeb[1] from Pontificia Universidad Católica del Ecuador, the Ecuadorian university with the most outstanding professional background in biological research, and FishBase[2] which updates fish databases at a global level.

[1] www.bioweb.bio

[2] www.fishbase.de

3. Ecologically Appropriate Area of Analysis

According to Performance Standard 6 of the IFC, the analysis of Critical Habitats requires the definition of the Ecologically Appropriate Area of Analysis. For that purpose, the potential distribution of valued species or ecosystems must be taken into consideration, as well as the patterns, processes, characteristics and ecological functions necessary for their maintenance, whether it be within or beyond the project area of influence limits.

In order to define the Ecologically Appropriate Area of Analysis, it is required that the ecosystems developing in the project vicinity be identified. The term ecosystem (the integration of living beings, i.e. biocenosis, and the environment, i.e. biotope) is useful when related to the concept of Habitat which, according to the ND6 of the IFC at the section devoted to biodiversity protection and conservation, is defined as the terrestrial, riverine or marine geographical unit or airway that sustains the lives of groups of living organisms interacting with the non-living environment.

Puerto Bolívar Expansion Project Stage 1 is located at Puerto Bolívar parish in Cantón Machala, El Oro province, on the southern coast of Ecuador. El Oro is a province that harbors 18 types of different ecosystems throughout its surface of over 5,000 km^2 (GADPEO & INABIO, 2018). This ecosystem variety is largely influenced by its topography dominated by broad coastal plains, particularly characterized by mangroves, grasslands and lowland forests that are traversed to the south by the Andes mountain range with the Chilla and Tahuín formations, and which accommodate from moorland forests and grasslands to foothill, semi-deciduous and evergreen forests. The northeast region comprises the foothills that descend from Mollepungo mountain range until reaching the Gulf of Guayaquil (GADPEO & INABIO, 2018).

Basing the analysis on the project area of indirect influence, it is observed that this area is located at the oceanic coastal interface of Canal de Jambelí and Archipiélago de Jambelí, where important marine habitats develop, such as the mangrove ecosystem and marine habitats of high biodiversity such as Canal de Jambelí and Isla Santa Clara. Likewise, the continental coastal border and Isla Puná at its southern end show the presence of a mangrove ecosystem, interrupted throughout its entire distribution by shrimp farms. At the continental region, only modified habitats can be found, e.g. The Machala urban region, bordered almost entirely by banana monoculture plantations. The presence of these soils fully transformed for intensive production purposes significantly hinders the potential ecological connectivity with other natural habitats, which begin to reappear towards the east in the vicinity of Los Andes mountain range, and towards the south at the Arenillas region characterized by the presence of dry forests.

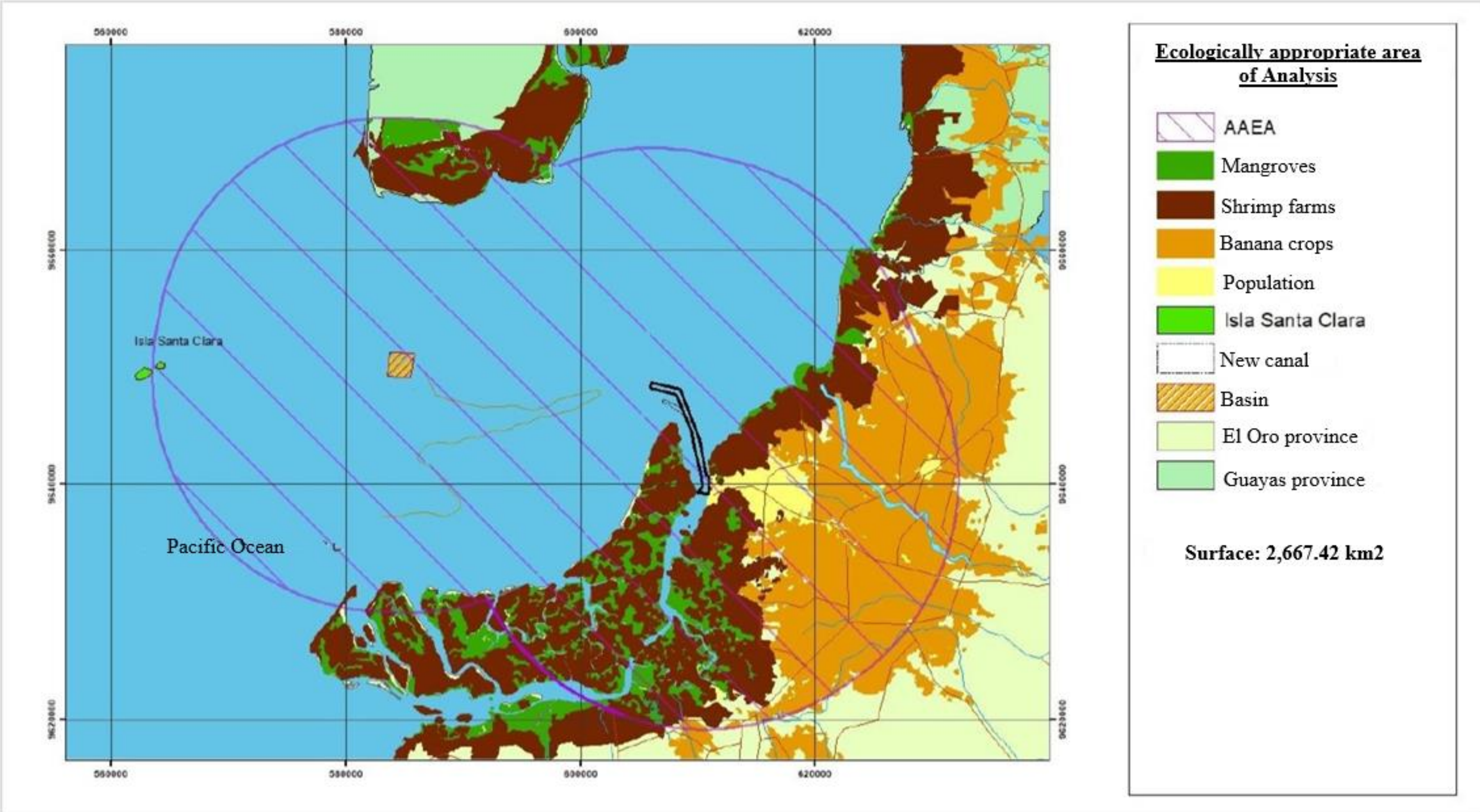
Table 2. Natural and modified habitats, and occupied surface within the AAEA.

Ecosystem/ Habitat	Type of Habitat	Surface area (km^2)
Isla Santa Clara and the marine reserve	Natural	43.00
Mangrove	Natural	145.85
Canal de Jambelí and oceanic area	Natural	1,300.00
Shrimp farms	Modified	563.42
Banana crops	Modified	462.36
Isla Puná	Natural Modified	60.00
Urban area	Modified	56.74

The area of indirect influence is deemed sufficiently representative to be used as the Ecologically Appropriate Area of Analysis (AAEA) for the study of critical habitats, given the presence of the main marine coastal ecosystems which are essential for the biodiversity of the region, and for their importance in providing the ecosystem services in Figure 1.

The AAEA has a surface area of 2,667 km^2, of which 2,169.36 km^2 pertain to the marine and marine coastal region.

Figure 1. Ecologically Appropriate Area of Analysis.



3.1 Description of the AAEA.

The southern region of the Gulf of Guayaquil shows distinctive hydrological and oceanic characteristics: it is the region that makes the most significant freshwater contribution to a marine system given its location south of Río Guayas river mouth, which entails a major supply of organic matter and continental nutrients that increase its primary productivity: on its oceanic side it receives a boost of oxygen, and a thermal regulation originating from the cold Humboldt Current, which entails an ecotone among coastal species of warmer inner currents and species from colder oceanic water bodies.

From a physical perspective, 3 main regions can be distinguished that will influence the habitat distribution of present resources and which will ease subsequent assessments, namely: Canal de Jambelí, Archipiélago de Jambelí and Isla Santa Clara.

Canal de Jambelí. Its source is at the mouth of Río Guayas, and continues along Archipiélago de Jambelí. It borders Isla Puná to the north and the Ecuadorian continental coast to the east; the approximate length of the canal is 70 km, with a width of 10 km at its initial section and of 30 km at its final end. It has the typical funnel shape ending in marine terraces as a result of tectonic uplifts (Rada, 1986).

Figure 2. Satellite image showing sediment entrainment in Canal de Jambelí

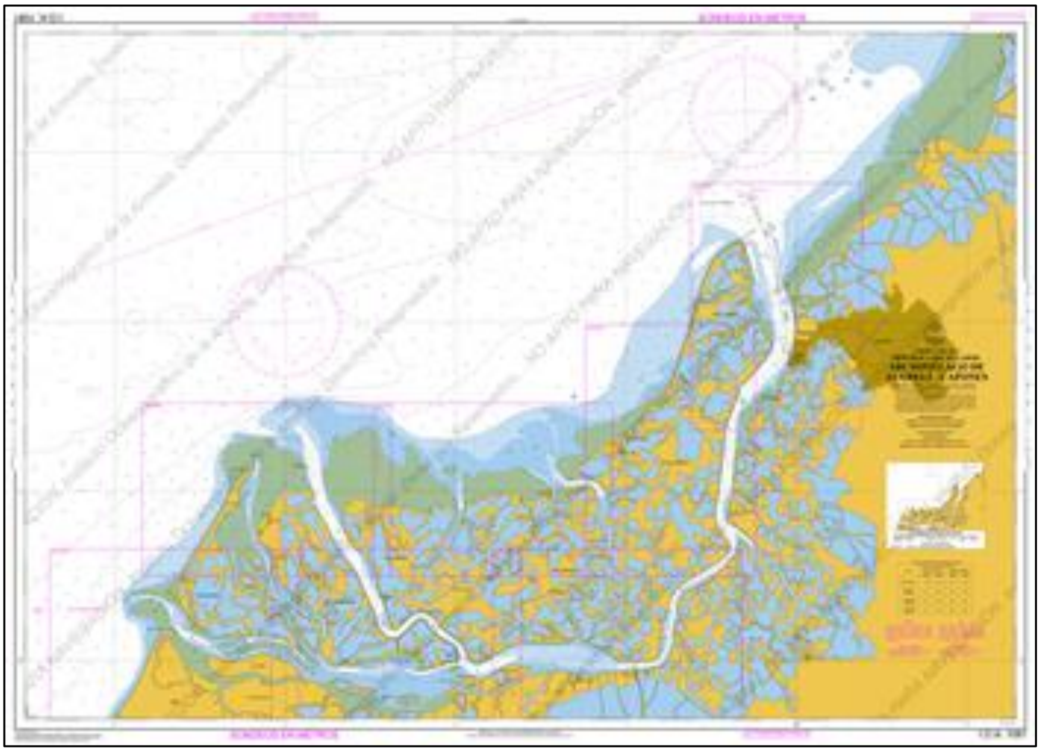
The maximum depth recorded at the mouth of Canal de Jambelí is 90 m, and its middle course oscillates between 50 m and 70 m; it is characterized by the sole presence of soft bottoms and ample intertidal spaces in the continental margin as illustrated in Figure 2 with green and light blue colors, where the access to coastal towns is restricted to high tides, thus its residents must install demarcation “handles” associated with water stream mouths to the canal which in turn enable routes that vary constantly so as to access or set sail in smaller vessels.

Mariana Jácome de Solórzano and Liliana Llanos studied the sediments at Canal de Jambelí in 1987, and pointed out that on the coastal border regions there was an abundance of silty clay sediments with 60% silt content, 35% clay and 5% sand; further away from the coastal border there was a predominance of silty sediments with 70% silt, 20% clay and 10% sand; in addition to sandy silt sediments with 35% silt content, 10% clay and 55% sand located towards the mouth sector, and finally sandy sediments covering small segments of the canal which have 20% silt, 10% clay and 70% sand.

Canal de Jambelí consists of a natural habitat of estuarine waters with soft bottoms, being high turbidity one of its main characteristics as can be appreciated in satellite images that show its major riverine influence, and therefore, it has significant drag and sediment dispersion, as shown in Figure 2. Canal de Jambelí is flanked on both sides by mangroves, which will be commented on later.

Archipiélago de Jambelí. The main isle is a sandy formation of medium grain size D50 equal to 0.48 mm, and is located approximately at 3 m above sea level. Tidal range oscillates between 2 m and 2.5 m. Erosion processes are abundant at Isla Jambelí, being waves and sea level changes the main sources of this issue, such that abnormal effects like El Niño or Pacific tropical storms cause serious damages in a few hours or days (Leonor Vera, 2007).

Figure 3. Archipiélago de Jambelí, chart 1081



Source: www.inocar.mil.ec

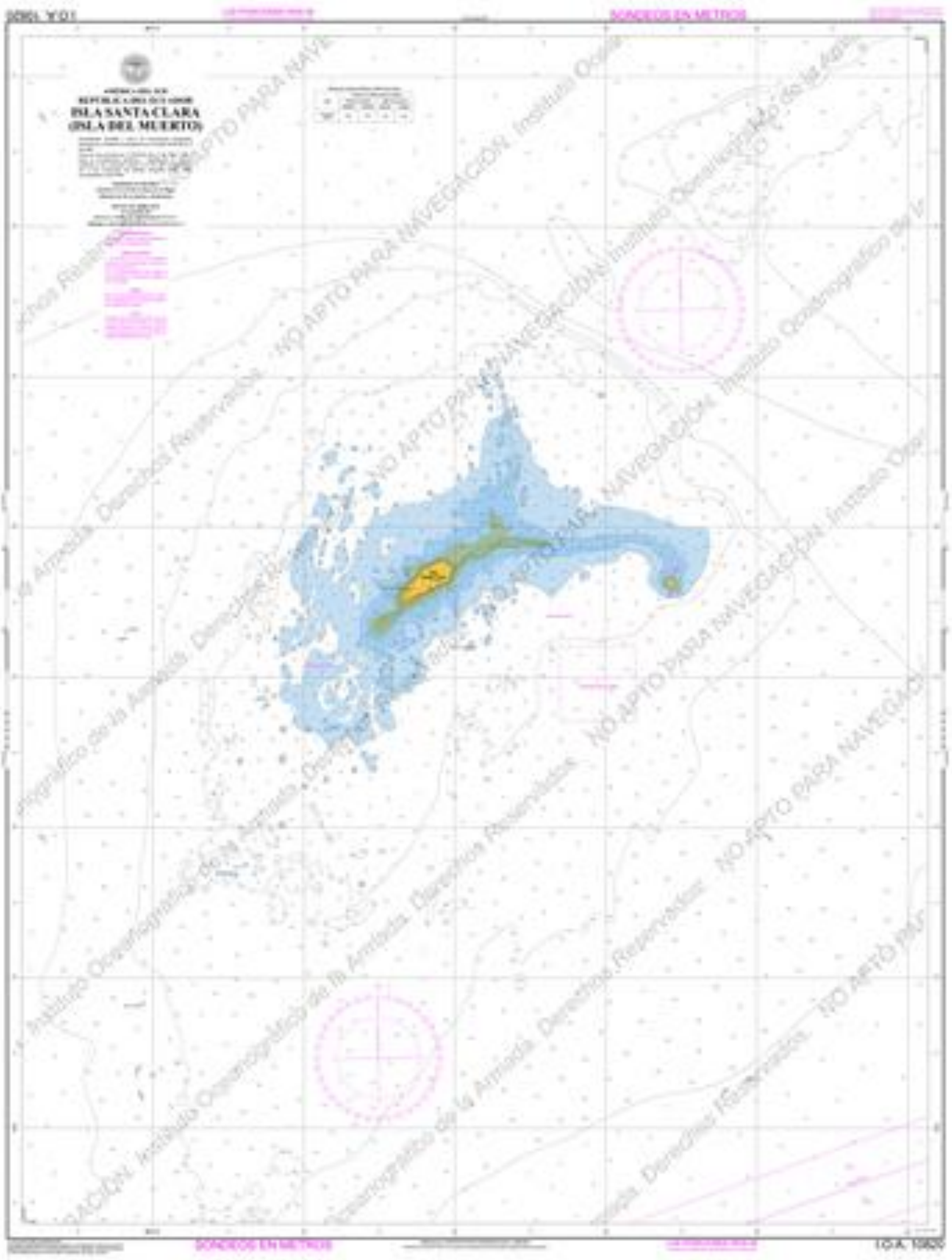
Figure 3 shows that Archipiélago de Jambelí has multiple inner water streams with mangrove presence dominated by the *Rhizophora mangle* species (Red Mangrove) and very few salt pans and highlands. Towards the segment under sea exposure, there are intertidal spaces several kilometers long with low tides, being coastal navigation restricted to smaller vessels. The heaviest soil use in the archipelago pertains to shrimp farms that have altered the ecosystem. The main intertidal regions correspond to natural habitats, critical habitats (mangrove remains) and modified habitats, shrimp farming and tourist structures.

Isla Santa Clara. Figure 4 Shows the nautical approach chart to Isla Santa Clara, which has several rocky islets that form Isla Santa Clara Wildlife Refuge. It is located 50 km west of Puerto Bolívar, 25 km off the south coast of Isla Puná and 125 km SSW in the direction of Guayaquil, its geographical position is 3° 10´13” S and 80° 26´11” W. (Position of the lighthouse belonging to INOCAR).

The part above sea level presents an enlarged shape towards the northeast and is constituted by several islets, of which the main one, considered the largest island, has a maximum width of 240 m between the cliffs’ feet and 400 m including the beach during low tide, and is 850 m long. The beach belt appearing during low tide connects the island with the islets, both to the northern and southern regions, and is 2,600 m long.

According to INOCAR bathymetric charts, the region corresponds to a rocky platform. At a regional scale, bathymetry continues to show a platform less than 30 m deep bordered by plains of 30-50 m to the east and bottoms of 100 m to the west. The platform less than 30 m deep measures 13 km by 11 km and is enlarged to the NE-SW direction. The shape of this platform highlights structural directions, mainly NE-SW, a line NNE-SSW, and a potential structural valley in the NW-SE direction, north of the island. (E. Santana and J.F. Dumont, 2000). Consequently, this marine region is being referred to as natural habitat of oceanic waters and hard bottoms; likewise, as will later be discussed, it has a high ecological significance, hence it is protected by the Ecuadorian government. It should be pointed out that it is located outside Puerto Bolívar project direct area of influence.

Figure 4. Approach chart 10820 to Santa Clara.



Source: www.inocar.mil.ec

4. Compliance with Critical Habitat requirements

4.1 Criterion 1: Critically endangered species or threatened with extinction.

According to Puerto Bolívar Expansion -Stage 1 IBAT Report (2021) (Annex 1), there are 1,804 biological resources within a 50 km range around the project which could potentially be found in the area.

As has already been mentioned, the AAEA pertains primarily to marine and marine coastal ecosystems, which is why the IBAT database was filtered towards marine beings while the search was limited to the following animal classes: *Actinopterygii*, Birds, *Bivalvia*, *Chondrichthyes*, Gastropods, *Holothuroidea, Malacostraca, Mammalia*, *Myxini* and *Reptillia*, ruling out terrestrial and freshwater species. The plant search was narrowed down to mangrove-related herbaceous families.

Flora: No resources in the CR or EN categories were reported within the herbaceous species of the mangrove ecosystem, there being records for the area of influence from which database 17 herbaceous resources were filtered and identified by Red List as being related to mangroves, all of them categorized as LC, OR, LR/LC (Least concern) and a single resource given the NT (Near threatened) category. Herbaceous species considered by Red List appear in the Annex 2 document.

Marine invertebrates: Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) informs the presence of the Holothurian *Isostichopus fuscus* (sea cucumber) which has been spotted by team members at Santa Clara intertidal rocky outcrops.

Photographic record 1. Isostichopus fuscus (EN) at Isla Santa Clara

Among other invertebrates related to fishery resources recorded during monitoring procedures, a unique specimen of green spiny lobster *Panulirus gracilis*, a species in the DD category, was captured and later returned to its environment unharmed. A permanent prohibition is in force on the extraction of green lobsters in the Ecuadorian jurisdiction, since the efforts that went into controlling their illegal capture have failed and their populations are markedly declining.

Marine birds: Marine birds in the CR and EN categories could be found in the entire coastal border and do not tend to gather, unlike marine birds in the least concern category whose presence corresponds to wandering individuals mainly related to Isla Santa Clara, among which the following fall into the CR and EN categories:

- *Pterodroma pheaopygia* or Galapagos petrel (CR)
- *Phoebastria irrorata* or Galapagos albatross (CR)
- *Sternula lorata* or Peruvian tern (EN)

The first two species have not been reported in local inventories, whereas the Peruvian tern has been observed at offshore platforms south of Isla Santa Clara during the 2013 to 2015 period.

Fish: Upon filtering the database towards bony fish (*Actinopterygii*) within a 50 km radius from Puerto Bolívar (Annex 4b), a list of 596 species was compiled (an extensive record given that continental Ecuador would have nearly 780 species of marine fish). No bony fish was found in the CR and EN categories.

The outcome is different upon filtering the database towards *Chondrichthyes* or cartilaginous fish (rays and sharks or batoidea), where the IBAT PB database showed 7 species in the CR category and 9 in the EN category.

None of the species listed by IBAT in the EN and CR categories were observed during the bimonthly fishery productivity monitoring procedures conducted on a standardized sampling effort during the 2018 to 2020 period or in the traditional fishery tracking procedure of November 2020, although the whale shark *Rhincodon typus* (EN) and large rays *Mobula birostris* (EN) have been observed in the vicinity of Isla Santa Clara, where diving encounters with *Squatina armata* (CR) or angelshark have taken place. A brief description of these appears in Annex 7. CR/EN/VU species reported by IBAT in the project area of influence.

It is worth pointing out that during the fishery productivity monitoring procedures conducted at the dredged sediment disposal site, it was requested by MAAE that the fishery productivity analysis near Isla Santa Clara be included where, on one occasion, the pygmy devil ray *Mobula munkiana* categorized as vulnerable (VU) was captured, and in another, the whale shark *Rhyncodon typus was observed, in addition to freeing the below species from catches performed within the dredged sediment disposal site:*

- Whitesnout guitarfish *Pseudobatos leucorhynchus* (VU)
- Longnose eagle ray *Myliobatis longirostris* (VU)
- Sarten picuda *Urotrygon rogersii* (NT)
- Whiptail stingray *Dasyatis brevis* (not in the Red List)

- Equatorial rays *Rostroraja equatorialis and Raja sp* (VU)

During the monitoring of fish in Estero Santa Rosa, at regions closer to Puerto Bolívar, a unique capture of two giant seahorses *Hippocampus ingens* (VU) and several Equatorial rays were released unharmed.

Mammals: As regards mammals, Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) provided 9 mammal records; 6 of them were marine ones. 5 dolphin species were mentioned, all of them oceanic and in the least concern category, mainly approaching Canal de Jambelí in seasonal transition periods, time during which *Stenella coeroleualba* individuals were observed on several occasions at the dredged sediment disposal site area, in addition to an outstanding report of a beaked whale *Mesoplodon peruvianus*, also categorized as least concern, although no reports were submitted on the presence of migratory whales such as *Megaptera novanglieae*, also in the least concern category, or of common bottlenose dolphins *Tursiops truncatus* whose population at Canal de Jambelí and Estero Salado worries national researchers due to constant reports of its decline. Marine mammals and reptiles filtered from Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) are listed in the Annex 6 document. Among otariids, South American sea lions, southern sea lions *Otaria flavescens (Shaw, 1800),* marine sea lions, referred to as *Otaria byronia* in the Red List, are in the LC category and will be commented on in the third criterion.

Marine reptiles: Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) yielded only 6 records of marine reptiles:

Chelonia mydas or green sea turtle (EN): Out of 3 encounters with this sea turtle in the 2018-2020 period, only one pertained to a live individual, while the other two were floating carcasses which presumably died as a result of interactions with fishermen using longline fishing techniques.

Crocodilus acutus, listed as VU in the Red List and CR in the national list (Carrillo et al, 2005): Their most frequent habitats in Ecuador are located in the Guayas province. They are rarely seen at the Jambelí canal and archipelago, which makes their sightings attention-grabbing events. The last capture event of a specimen larger than two meters in the area of influence was performed in November 2020 by fishermen in Estero Pilo south of Puerto Bolívar.

According to Carvajal, Savedra and Alva, 2005, an average of 0.27 to 0.63 individuals per km (0.48 on average) would exist in El Salado reserve, Guayas province, at regions near Guayaquil surrounding urban area. The highest number of individuals was found at Estero Palo Seco which, according to the research, corresponds to the species ideal microhabitat: those where low and deep regions alternate and which possess an adequate area of land for nesting and basking. The population density of Tumbes mangroves in Peru is the lowest (0.18 indv. /km); there, the registered population throughout 122 km is close to 22 individuals (Escobedo & Mejía 2003). It is quite possible for gene flow to occur between the Ecuador and Peru populations, specifically in individuals that would still be present at mangroves bordering

Peru; however, the existence of the species in Archipiélago de Jambelí, Ecuador, would need to be verified (Escobedo, 2004).

4.1.1 Criterion 1 result

According to Puerto Bolívar Expansion - Stage 1 IBAT Report (2021), there would be 22 species in the CR and EN categories which could potentially be found within a 50 km range around the project. Upon comparing it with two-year monitoring procedures in the site and other assessments conducted in the region, only 5 species in the EN category and one species in the CR category have been observed in the project area of influence, and they basically consist of sightings and encounters.

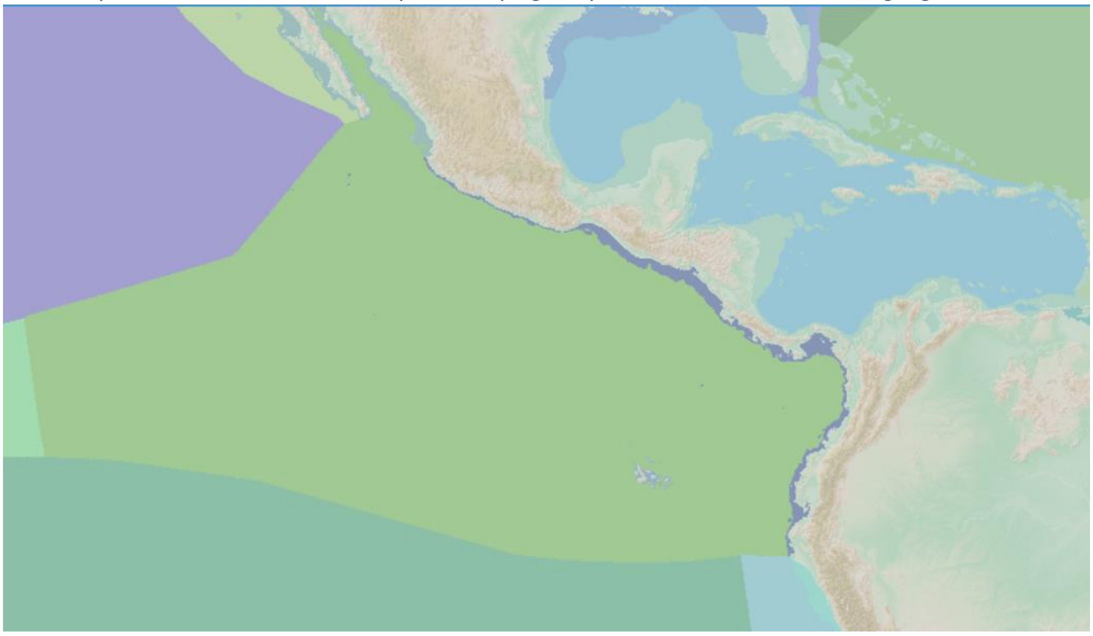
As regards the Vulnerable species, IBAT indicates that 36 species in this conservation category would be found in the AAEA, 8 of which have been captured and released or otherwise observed during biotic monitoring procedures and diversity assessments conducted in November 2020 (see Annex 7).

In search of additional data, a list of occurrence for species in the AAEA was downloaded from GBIF.org (14 May 2021). None of the species registered in this list coincides with the above list of VU, EN or CR species.

After analyzing the bibliographical and primary information, it was concluded that the AAEA cannot be considered a region of significant concentrations of endangered species at the global, national or regional level.

4.2 Criterion 2: Endemic and/or restricted-range species

Figure 5. Tropical eastern Pacific marine province (in green) and its continental shelf highlighted in dark violet.



Source: https://data.unep-wcmc.org/datasets/38

Endemism is a difficult condition in Puerto Bolívar since it belongs to a large marine ecoregion or pelagic provinces of the world known as tropical eastern Pacific province (Spalding et al, 2012), which extends from northern Peru until Baja California and covers a surface of 3,700,000 km^2, being provinces defined as extensive epipelagic ocean zones determined by large-scale oceanographic processes on a spatial and temporal scope (or with recurring seasonal patterns) where assemblies of species that share a coevolutionary history live. Taxonomic refinement can typically be driven by a staged isolation of the ocean borders and hemispheres.

Most marine and bird species in the AAEA[3] can also be considered endemic to the "Tumbes-Choco-Magdalena" ecoregion, one of the 36 biodiversity hotspots[4] identified worldwide, which comprise 1,500 km of coast from Panama until northern Peru, harboring 2,750 plant species and 364 animals ones (Weller et al., 2017). It also preserves 6,200 km^2 of mangrove forests which correspond to the region's main coastal biome.

Almost all the observed resources in the project area of influence during the monitoring of fish, marine mammals, reptiles and marine invertebrates, as well as the resources identified in bibliographical searches (birds) are also reported in other mangrove coastal regions north of the country, despite direct connectivity interruptions since mangroves practically disappear from Santa Elena and Manabi coastal borders to reappear as of northern latitude 0°, which belongs to the border of Manabí and Esmeraldas provinces; the hydrologic connectivity of local currents on the continental shelf is evidenced by the similarities among fish and marine invertebrates. Mangroves in northern Ecuador are connected with Chocó mangroves in Colombia and are deemed to be better preserved. Some emblematic species such as shells in the Anadara genus, of major social importance in the project area of influence, can be found from Central America and Baja California to northern Peru.

The *Living National Treasures*[5], an organization specialized in recording endemic species, reports the following as being the most important endemic species in the country: The Galapagos sea lion *Zallopus wollebaeki*, the Galapagos fur seal *Arctocephalus galapagoensis*, the eastern caenolestid *Caenolestes sangay*, the South American shrew *Cryptotis niausa*, the Sacha guinea pig *Cavia patzelti*, the wandering Oldfield mouse *Thomasomys erro,* the Galapagos rice rat *Aegialomys galapagoensis*, the Santiago Galapagos mouse *Nesoryzomys swarthi*, the Ecuadorian grass mouse *Neomicroxus latebricola*, the Hammond's rice rat *Myndomys hammondi*, the Ahuaca mountain viscacha *Lagidium ahuacaense*, the equatorial dog-faced bat *Cabreramops aequatorianus*, the Gualea red brocket *Mazama gualea* and the Simons' dwarf squirrel *Microsciurus simons*i.

[3] BirdLife International (2021) Country profile: Ecuador. Available from http://www.birdlife.org/datazone/country/ecuador. Checked: 4/24/2021

[4] Biodiversity hotspots cover only 2.3% of the land surface and harbor 50% of known life forms.

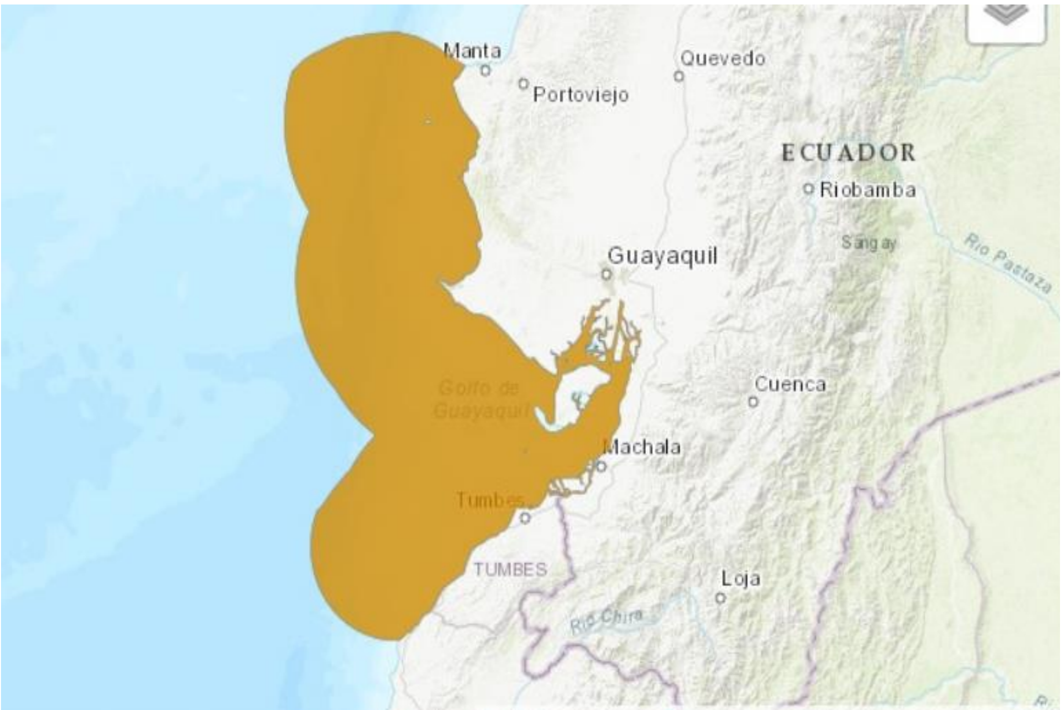
[5] http://lntreasures.com/index.html

According to *Living National Treasures*, there are 39 species of endemic marine fish in Ecuador, all of which are found in Archipiélago de Colón and the Galapagos Islands located 1,000 km from the AAEA.

As to restricted-range species based on their distribution or extent of occurrence (less than 100,000 km^2), two fish are listed in the Red List, both in the VU category, and none under any national category:

- **The wrasse *Paraclinus fehlmanni* or "Trombollito de Fehlmann"**: unique to intertidal ponds at the Ecuadorian-Peruvian border. Its distribution reaches approximately 20,000 km^2

Figure 6. Paraclinus fehlmanni EOO



Source: https://www.iucnredlist.org

Specimens have been captured during intertidal samplings that may belong to said species and which were released. The samplings were focused on the infauna of muddy beaches in Archipiélago de Jambelí and of intertidal ones in Isla Santa Clara.
Due to the lack of population estimates, the marine coastal area of the AAEA was compared to the species total area of occurrence to determine the estimated significance of the habitat to the species survival. This was done despite the absence of a constant population distribution or known regions of higher or lower occurrence throughout the distribution. It will be estimated that a percentage above 10% could sustain a population above the 10% estimate for critical habitats in criterion 2.

As for this species, it is calculated that the area of the AAEA represents 13.33% of the total area of occurrence.

Photographic record 2. Pond wrasses, left Isla Santa Clara, right Archipiélago de Jambelí

- The ***Urobatis tumbesensis*****,** an endemic ray that occurs from northern Peru until Colombia. With an extent of occurrence less than 20,000 km^2, it is estimated that AAEA represents 13.33% of the species area of occurrence.
  This species has not been observed in the monitoring procedures conducted in the AAEA.

Figure 7. Urobatis tumbesensis EOO

Source: https://www.iucnredlist.org

4.2.1 Criterion 2 result

According to NO74, two fish species in the AAEA are endemic or restricted-range: *Paraclinus fehlmanni* and *Urobatis tumbesensis*. In the absence of population estimates and since the criterion compliance has not been established, its presence was estimated based on the percentage of the studied area of AAEA compared to the total area of occurrence; in both cases, the obtained value was 13.33%, which qualifies this region as a critical habitat according to criterion 2.

4.3 Criterion 3: Migratory and/or congregatory species

Migratory species

In agreement with Ecuador's CMS[6] country profile, 63 migratory species from South American, Central American and Caribbean regions have been entered in the country's records, most of which conform to UICN Red List; in addition, after being filtered towards marine species, the list was reduced to 43 species which are detailed in the Annex 9 document.

Cartilaginous fish such as rays and sharks stand out among the migratory species observed in the project area of indirect influence (within waters near Isla Santa Clara) in addition to marine mammals, the most emblematic of which is undoubtedly the humpback whale *Megaptera novaeangliae* that migrates each year from Antarctica to the tropical waters of Ecuador and Colombia for mating and copulation that take place from early May until mid or late October each year, and which has turned into a tourist attraction for local visitors that embark from Puerto Bolívar Cabotage Pier towards Isla Santa Clara. This species is estimated to have a population of 50,000 individuals (Branch, 2007), with the unlikely presence of 500 whales in the vicinity of Isla Santa Clara and the area of influence of Puerto Bolívar project, given the water turbidity conditions associated with Canal de Jambelí.

With regard to pelagic sharks, they are not as abundant in this region as they are in other coastal regions of Ecuador such as Esmeraldas and Manabí. No specimen has been captured after 2 years of monitoring procedures, neither do they show at fishery terminals.

Congregatory species

Figure 8. Protected areas and KBAs in Puerto Bolívar project region shows, in a weave of vertical lines, the sites regarded as bird gathering spots. Table 3 classifies as IBA *A4* such areas that are significant for the conservation of birds regarded as congregatory which "are known or believed to harbor congregations of ≥1% of the world population of one or more species in a regular or predictable manner"; namely:

- Jambelí and the mangroves of Guayaquil

[6] Convention on Migratory Species

- Isla Santa Clara and Wildlife Refuge

Jambelí and the mangroves of Guayaquil: Mangroves play a highly important role in bird congregation and bioaquatic species migration: root entanglement, pneumatophores and submerged mangrove branches create nursery habitats, which are defined as "habitats for a particular species that proportionally contribute with a higher number of individuals than the average of adult individuals per unit area generated by other habitats used by their juveniles", and which are of ecological significance to the general maintenance of ecosystem functions (Dahlgren et al., 2006).

Most aquatic birds identified in the country settle in mangroves. According to Agreda (2017), the Gulf of Guayaquil, Archipiélago de Jambelí and Río Chone estuary are the main congregation habitats, where 24 Nearctic beach migratory species were recorded. The most abundant of these are *Calidris pusilla* (semipalmated sandpiper), *Calidris mauri* (western sandpiper), *Numenius phaeopus* (Eurasian whimbrel) and *Charadrius semipalmatus* (semipalmated plover).

At the southern mangrove area of Guayaquil, it was discovered that the largest groups pertained to the following families: sandpipers (*Scolopacidae*) with nine species and 212,795 individuals, terns (*Sternidae*) with three species and 17,954 individuals, plovers (*Charadriidae*) with three species and 9,430 individuals and herons (*Ardeidae*) with nine recorded species and a total of 8,999 individuals. (Agreda, 2019).

Canal de Jambelí comprises >10% of the biogeographic population of the semipalmated sandpiper *(Calidris pusilla)*, at least 9% of the Eurasian whimbrel *(Numenius phaeopus),* 7% of the semipalmated plover population *(Charadrius semipalmatus)* and 3% of the American oystercatcher *(Haematopus palliatus),* (available from https://avesconservacion.org).

Bird gathering at Isla Santa Clara: Isla Santa Clara has, without a doubt, the largest congregation of marine birds and pinnipeds from the southern coast of Ecuador, which is why it is protected by the Ecuadorian government. Here, the populations of blue-footed boobies *Sula nebouxi*, in the least concern category with no estimated population according to Red List, frigatebirds *Fregatas magnificens*, as well as brown pelicans *Pelecanus occidentalis* and Peruvian pelicans *Pelacanus thagus* are estimated by the thousands. Among marine mammals, the best-known inhabitant showing significant population fluctuations is the sea lion *Otaria flavescens*, whose main colony consisted of over 150 individuals in April 2021, this species was reported as *Otaria byronia* which, according to Red List, would have a population of 222,500 individuals; in northern Chile alone, a population close to 69,000 sea lions was estimated in 2012 (Contreras Von Meyer, 2012); also, this species is considered native to Brazil, Uruguay, Argentina, Chile and Peru, as well as present and wandering in Ecuador and Colombia; in more abundant years, the estimated number of sea lions at Isla Santa Clara has reached near 750.

Photographic record 3. Sea lions Otaria flavescens, center blue-footed boobies Sula nebouxi and bottom abundance of birds at Isla Santa Clara, 10 April 2021

4.3.1 Criterion 3 result

Mangroves (Jambelí and Guayaquil) and Santa Clara are important areas for the congregation of aquatic bird species, and of South American sea lions within the context of Ecuador. As to the semipalmated sandpiper (*Calidris pusilla*), the consulted bibliography indicates that the Gulf of Guayaquil region will fulfill criterion 3a.

This is confirmed via the IBA classification, which regards both ecosystems as "sites that harbor congregations of ≥1% of the world population of one or more species in a regular or predictable manner", thereby fulfilling criterion 3b.

4.4 Criterion 4: Unique and highly endangered ecosystems:

Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) has compiled a list of 5 Protected Areas (a list of Peru included) and 4 Key Biodiversity Areas (with the exception of two Protected Areas that are listed here again).

Protected Areas are natural regions that ensure the coverage and connectivity of key terrestrial, marine and marine coastal ecosystems, their cultural resources and main water sources. These are part of the National System of Protected Areas (SNAP).

Key Biodiversity Areas (KBAs) are sites that substantially contribute to the preservation of biodiversity in terrestrial, freshwater and marine ecosystems. The sites are classified as global KBAs if they fulfill one or more of the 11 criteria, which are grouped into five categories: threatened biodiversity; restricted-range biodiversity; ecological integrity; biological processes; and irreplaceability. KBAs comprise a "general" group of priority biodiversity sites with international recognition, which include Important Bird and Biodiversity Areas (IBAs); and *Alliance for Zero Extinction* (AZE) sites.

Protected Areas.

According to Puerto Bolívar Expansion - Stage 1 IBAT Report (2021), within a 50 km radius from Puerto Bolivar project location, the following areas can be found which belong to the National System of Protected Areas of Ecuador. As has already been stated, this list includes a protected Area located at northern Peru, bordering Ecuador.

Arenillas Ecological Reserve, founded on 16 May 2001. It is located in El Oro province, between cantons Arenillas and Huaquillas, and has an expanse of 13,170 hectares. Climate is warm and dry with a temperature that exceeds 24 °C, the type of vegetation is mangrove, deciduous and semi-deciduous lowland forest, dry scrubland and coastal cactus. Flora is typical of the area and fauna is made up of 60-80 mammal species and 153 registered bird and amphibian species (Aguirre, 2014). The ecosystem is characterized by high levels of flora and fauna endemism that can only be found in the Ecuadorian dry forest at southern Ecuador and northern Peru (Ministry of Environment, 2015).

Wildlife Refuge and Isla Santa Clara Marine Reserve. Founded via Ministerial Resolution A-83 on 6 March 1999. It is located at the Gulf of Guayaquil entrance, 43 km west form Puerto Bolívar in El Oro province. It covers 7 hectares of land and 2 nautical miles around the isle and islets. Flora is dominated by scarce herbaceous coverage of the dry scrubland type, and fauna consists of 4 mammal species, 29 birds, 4 reptiles and 37 invertebrates (Aguirre, 2014). The high marine productivity and the abundance of nutrients in waters has enabled the convergence of several species. Thousands of marine birds, such as frigatebirds, blue-footed boobies and pelicans make up one of the largest colonies of these species in the entire country, which is why in 2002 it received an international acknowledgment and was cataloged as a Ramsar site (Ministry of Environment, 2015).

La Tembladera. La Tembladera wetland is located in El Oro province, 17.5 km from Cantón Santa Rosa. It consists of a permanent lagoon and its flooded surrounding areas located at the Tumbes Endemic Birds Area, and is home to at least 24 endemic bird species, such as the Ecuadorian ground dove (*Columbina buckleyi*) and the Pacific parrotlet (*Forpus coelestis*), endangered and vulnerable species in the Red List such as the gray-cheeked parakeet (*Brotogeris pyrrhoptera*) and the rufous-headed cachalaca (*Ortalis erythroptera*). The lagoon supplies water to the irrigation systems for agriculture and livestock activities in the surrounding area and supports small-scale fishery. Threats to the site include habitat pollution and destruction due to the growth of agricultural and livestock activities operating in the wetland.

Manglares de Tumbes. Santuario Nacional los Manglares de Tumbes is located northwest of Peru in the Zarumilla district (Tumbes), and has an expanse of 2,972 ha. It was declared protected area in March 1988. The ecosystem is typical of a tropical region and is named after the vast mangrove expanse. Among the typical species in the region are the mangrove crab, prawns and the pustulose ark. Besides the rich biodiversity, it offers a significant contribution to the nearby towns by means of the hydrobiological products obtained from the ecosystem (SERNANP, s.f.).

Key Biodiversity Areas (KBAs)

Archipiélago de Jambelí. Is located in front of El Oro province coasts, south of the Gulf of Guayaquil and 2 km from Puerto Bolívar. It has a 293 km expanse. The archipelago consisting of 5 isles was one of the areas referred to as Special Management Zones (SMZs) established in 1989 as part of the Fishery Resources Management Program implementation. Currently, the archipelago is no longer under any state control or monitoring mechanism. As is the case with any marine coastal ecosystem in the region, it has been highly intervened throughout the years, particularly by the shrimp farming industry which decimated its mangrove forests, thus leaving patchy remains of undeniable ecological value that are currently being watched over by self-supporting fishery associations. As of 2016, the mangrove surface of Archipiélago de Jambelí was 8,468.94 hectares (Flores et al, 2020), making up 5% of the total mangrove surface in Ecuador, which was calculated at 161,820 ha for that year.

The archipelago also has beaches which constitute the province’s main tourist destination.

Daucay. It consists of a foothill tropical rainforest located between El Oro and Azuay provinces. The region in surrounded by agricultural and pasture areas. The humidity is explained by the distance to the coastal line and its location at the Andes foothills. According to N. Krabbe in his 1993 visit, 135 species were recorded, among which are the *Pyrrhura orcesi*, a globally endangered endemic species in Ecuador, and the also endangered *scytalopus robbinsi* (BirdLife International, 2021).

Manglares del golfo de Guayaquil. The region referred to as Manglares del golfo de Guayaquil is located in cantons Guayaquil, Naranjal and Balao, as well as in Isla Puná. It is regarded as a highly significant region for congregatory species. This area contains Reserva de Producción Faunística Manglares de El Salado, the mangroves within the city of Guayaquil and the mangrove area run by the Cerrito de los Morreños community. Information on fauna is limited, although it is certain that there are aquatic and marine species that nest in and visit the region. Of special note is the presence of a large population of frigatebirds, the migration of sea lions and the diversity of commercially important fish (BirdLife International, 2021).

Buenaventura Reserve. Buenaventura Reserve is a region of tropical cloud forests belonging to Fundación Jocotoco since 1999, located at Cantón Piñas in El Oro province. With an expanse of 1,500 ha, it harbors a rich diversity of wild flora and fauna, mostly endemic and some endangered. It is one of the country sites which allows for an accessible ornithology. It is inhabited by approximately 320 bird species, 30 of which are endemic and 12 are endangered. National and foreign tourists visit it for birdwatching and to carry out ecotourism activities (AME, 2020).

Considering that the threshold for this criterion regards as critical the regions cataloged as: i) areas that fulfill the criteria for UICN categories of protected areas I.a, I.b. and II; ii) key biodiversity areas (KBAs) including areas important for bird conservation (IBA), iii) areas representing ≥ 5% of the world expanse of a type of ecosystem that fulfills UICN CR or EN condition criteria, the details on these characteristics for the assessed regions is shown in Table 3.

Merely on the basis of sub-criteria i and ii, it is concluded that Arenillas, Santa Clara, Jambelí, Gulf of Guayaquil, Buenaventura and Daucay would fulfill Criterion 3 (see the green-shaded cells in Table 3). However, a connection must be established as to the physical proximity to or the project’s potential interaction with these habitats.

Table 3. Assessment of protected Areas and KBAs of the project

Area	Ecosystem/ Habitat	National/ International Protection Category	UICN Red List	National equivalent*/ other criterion	IBA**/ AZE	Surface (km^2)	Global surface (km^2)	% of world expanse
Arenillas	Ecuadorian dry forest (Tumbes region)	Ecological Reserve		IA, IB or II	A1, A2, A3, A4i	131.78	55,000[7]	0.23%
Isla Santa Clara and Wildlife Refuge	Wetland	Marine Reserve, Wildlife Refuge, Ramsar		IV	A1, A4i, A4ii, A4iii	3.35	12,500,000[8]	0.000026%
La Tembladera	Wetland	Ramsar		---	---	14.71	12,500,000	0.00011%
Manglares de Tumbes	Mangrove forest	Santuario Natural (Peru)	III	III	---	29.72	154,085[9]	0.02%
Archipiélago de Jambelí	Mangrove forest	Special Management Zone (SMZ)	---	Section 119 of the Environmental Organic Code. Mangrove is declared of National Priority for management and conservation.	A4iii	79.48[10]	154,085	0.2%
Manglares del golfo de Guayaquil	Mangrove forest	Reserva de Producción Faunística Manglares de El Salado	---	Section 119 of the Environmental Organic Code. Mangrove is declared of National Priority for management and conservation	A4iii	21.71[11]	154,085	0.014%
Buenaventura	Tropical cloud forest	Private reserve.	---	---	A1, A2	3.45	539,263[12]	0.0022%

[7] Espinoza et al, 2021
[8] Ramsar Convention Secretariat, 2018
[9] Hamilton and Casey, 2016
[10] Flores-Aguilar, D. et al., 2020.
[11] Key Biodiversity Areas Partnership, 2020
[12] Bubb et al, 2002

Area	Ecosystem/ Habitat	National/ International Protection Category	UICN Red List	National equivalent*/ other criterion	IBA**/ AZE	Surface (km^2)	Global surface (km^2)	% of world expanse
Daucay	Tropical rainforest	Tropical rainforest	---	---	A1	13.21	10,900,000[13]	0.00012%

*MAE (2004). Policies and Strategic Plan of Ecuador's National System of Protected Areas 2007-2016

** IBA classification details: A1. Globally threatened species; A2. Restricted-range species; A3. Biome-restricted species; A4. Congregation; B1: Species of conservation concern.

[13] Ofosu-Asiedu, A. (s.f.).

Figure 8. Protected areas and KBAs in Puerto Bolívar project region

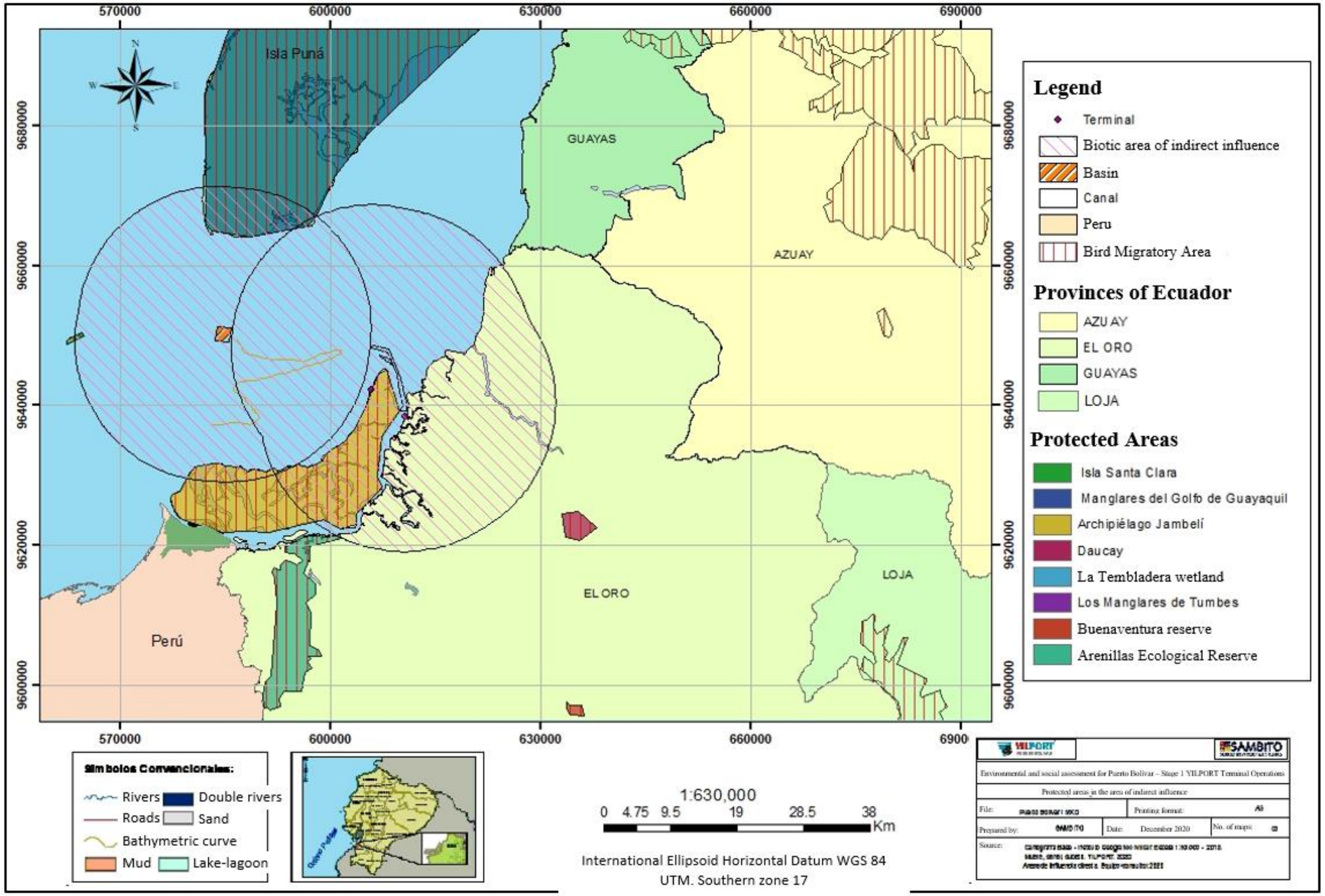


Figure 8 shows the location of protected areas and KBAs in relation to the AAEA. It can be observed that it essentially has the potential of interacting with or influencing marine coastal protected areas and KBAs, in addition to being mutually interrelated. On the other hand, La Tembladera, Buenaventura and Daucay located southeast of the Port are far from the project, have different characteristics and are relatively isolated from one another.

4.4.1 Criterion 4 result

As can be seen from the above analysis, **mangrove forests**, particularly those located in Archipiélago de Jambelí, are undoubtedly the most important ones for this assessment due to the following reasons:

- It is the marine coastal habitat which could interact the most with the project given its nature and proximity.
- They provide ecosystem services and are bird nesting sites
- They constitute a significant area compared to other habitats, and do not reach the thresholds laid down for critical habitats in relation to worldwide coverage.
- They are protected by the Ramsar convention on wetlands[14] of which Ecuador is signatory since 1991 with 19 protected sites, 4 of which are mangroves.
- Despite the legal instruments for their protection, they are threatened by the growth of agriculture, aquaculture, urban development and their very exploitation. In the last century, 50% of the world's mangroves were lost, and during the 1980-2000 period, 35% of the global coverage would have been lost (Giri et al., 2011); moreover, Ecuador lost 43% of the national mangrove coverage between 1969 and 1999

On the other hand, Isla Santa Clara is regarded as a unique ecosystem to the south coast of Ecuador which, though distant from the project area of influence, its marine environment may also be deemed threatened given its proximity to Puerto Bolívar access navigation route, and although the Ecuadorian government has given it the status of protected area, it presents severe logistic difficulties for its care. Additionally, precisely due to their ichthyological richness, they receive considerable pressure by traditional and semi-industrial fisheries.

4.5 Criterion 5: Key evolutionary processes:

Within a specific region, structural characteristics such as its topography, geology, soil, temperature and vegetation, and the combination of these variables, can influence the evolutionary processes that lead to the regional configurations of species and ecological properties. In some cases, unique and specific characteristics of a landscape have been associated with genetically singular species populations (IFC, 2019). Some attributes associated with evolutionary processes are: high spatial heterogeneity, environmental gradients, edaphic interfaces, habitat connectivity and proven significance for climate change adaptation.

[14] www.ramsar.org

4.5.1 Criterion 5 result

Pursuant to NO83 of ND6 in relation to this criterion, in most cases “it will be applied in previously researched regions which are known or assumed to be associated with singular evolutionary processes”.

As to the ecosystems and crucial biodiversity regions noted in this assessment, they do not meet the indicated characteristics to be regarded as ecosystems that sustain key evolutionary processes, which is why they do not fulfill criterion 5 for critical habitats.

5. Critical Habitat assessment results

Critical habitats are areas of high biodiversity levels that include at least one or more of the five values laid down in paragraph 16 of Performance Standard 6 or other recognized high biodiversity values; also, no criterion is less important than another when designating critical habitats, thus:

Table 4. Critical Habitat assessment results.

No.	Criterion	Results	Criteria fulfillment
1	Endangered (EN) or critically endangered (CR) species	5 species in the EN category and one species in the CR category have been observed at the AAEA, although their sightings are rare and generally of isolated individuals from limited captures. No population data on these species is available at the AAEA; therefore, there are no solid grounds to declare it a critical habitat.	No
2	Endemic or restricted-range species	Two endemic species of fish are located in the AAEA, both in the VU category: *Paraclinus fehlmanni* and *Urobatis tumbesensis*. Both species are deemed to fulfill this criterion since the AAEA, where they are located, represents over 10% of the total EOO.	Yes
3	Migratory or congregatory species	Mangroves (Jambelí and Guayaquil) and Santa Clara are important areas for aquatic bird species congregation. As to the semipalmated sandpiper (*Calidris pusilla*), the consulted bibliography indicates that the Gulf of Guayaquil region fulfills criterion 3.	Yes
4	Unique or highly endangered ecosystems	The mangrove and marine ecosystems, including Isla Santa Clara, are identified as highly endangered ecosystems.	Yes
5	Key evolutionary processes	The mangrove ecosystem shows evolutionary processes on the basis of its contribution to climate change adaptation due to its ability to achieve sedimentation in [sic] and coastal stabilization.	No

Prepared by: Ecosambito, 2020

Therefore, the above assessment determined the presence of Critical Habitats in the project area of direct and indirect influence, consisting of mangrove and marine ecosystems, including the RMISC.

5.1 Project relation to critical habitats

Although the area of influence of Puerto Bolívar Port Terminal contains critical habitats, the project establishment area has been operating for 60 years, whereas the expansion area is completely intervened. The closest mangrove area is Archipiélago de Jambelí, on the opposite side of Canal Santa Rosa, 2 km from the Port Terminal. Although this ecosystem will not be threatened by the expansion project, it is essential that conservation mechanisms be implemented given its biodiversity value.

As far as the marine area is concerned, the region surrounding Isla Santa Clara is located at the boundaries of the area of indirect influence, and may interact with maritime traffic; nevertheless, port traffic does not pose the main threat to this ecosystem, whose main pressure derives from the fishery activity.

6. Compliance with project requirements in critical habitats

According to paragraph 17 in the ND6 of the IFC, the following aspects and commitments must be proven so that the project can develop and operate in critical habitats:

a. there are no other viable alternatives within the region for the project to develop in natural or modified habitats which are not critical.

b. the project does not produce adverse quantifiable impacts on biodiversity values by virtue of which the critical habitat was designated or on the ecological processes that support said biodiversity values.

c. The project will not cause a net reduction in world or national/regional population of any endangered or critically endangered species for a reasonable period.

d. A long-term, well-designed, solid biodiversity tracking and assessment program will be integrated in the client management plan.

6.1 Lack of viable alternatives in the region

In 2016, by means of Administrative Ruling No. 31 -2016 of Puerto Bolívar Port Authority, YILPORT TERMINAL OPERATIONS is granted management license to the Port Terminal. Yet the ownership of Puerto Bolívar Port Terminal still belongs to APPB, and YILPORTECU assumes the operating and management functions of the Terminal, where it must realize its Expansion Project Stage 1. It must be remembered that Puerto Bolívar began in the late 18th century as a port enclave whose first settlement was Puerto Pilo, later referred to as Puerto Machala (between 1783 and 1860), Puerto de Huaylá (1861) facing Isla de Jambelí; and as of 1970, Puerto Bolívar Port Authority–APPB–was founded, which is responsible for managing the international maritime port. Nevertheless, the site was already a logistic enclave among former residents, who traveled to and from the current territories of Guayaquil and Puná, which were considered productive and commercial centers (Tapia, 2017).

On the other hand, the sediment disposal site was chosen based on its location characteristics, dominant currents and depth; and according to the provisions in the London Convention[15], which regulates waste material discharges in the sea and the adoption of all possible measures to prevent marine pollution. The site is located 13.75 miles from the sea buoy (25 km), and has depths between -27 and -36 MLWS, with predominant currents towards the northwest, thus sending disposed of sediments in that direction; moreover, as per the results of the sediment dispersion modeling provided, it was concluded that the area required for the sedimentation of fine materials under extreme and conservative tidal conditions will not interfere with the activities associated with the use of the water resource at a distance of 1.48 km and 1.84 (at surface level and below, respectively) during ebb tide; and up to 6.02 km during flood tide.

6.2 Absence of adverse quantifiable impacts on biodiversity values

According to the “final report of the research project bearing Authorization No. 002-2019-IC-FLORA/FAUNA-DPAEO-MAE: wildlife species specimen collection for conducting environmental assessments and other instruments for environmental regularization” (Annex 10), from where the results of biotic monitoring procedures carried out between 2018 and 2020 were obtained, the following conclusions have been drawn regarding the biological richness, abundance and diversity at the offshore sediment basin area in the outer limit of the RMISC and the port pier apron:

The benthic community at the offshore sediment basin receives most of the impacts since the extracted sediments accumulate in the existing community, whose richness and abundance is adversely affected and decreases considerably; this impact is nevertheless temporary during dredging maneuvers, and a meaningful recovery begins to show after two months. A greater richness of benthic resources is observed at Santa Clara station, mainly due to the presence of mixed seabeds which provide more habitats and thus enable the settlement of a larger number of species, whereas the stations at the dredged sediment disposal basin are silty, muddy and of fine sand, which makes it reasonable to find less variety of life-forms in a much more homogeneous environment.

[15] See more at https://www.imo.org/es/OurWork/Environment/Pages/London-Convention-Protocol.aspx#:~:text=El%20Convenio%20sobre%20la%20prevenci%C3%B3n,est%C3%A1%20en%20vigor%20desde%201975.

As regards fish, the area seemingly has productive cycles associated with the winter-summer seasonal change, and no fishery reduction has been observed in the dredged sediment disposal basin. No escape of fishery species took place during the dredging maneuvers period; in fact, out of 32 captures, the sampling on 17 April 2019 at the disposal basin station was the fourth most diverse catch in the studied period, and the captures with the smallest number of captured resources occurred on 5 December 2019, 6 months after the dredging maneuvers. With respect to local fishery productivity, the results of a two-year bimonthly systematic tracking procedure with offshore and inner-water standardized captures did not show any significant reduction that could be attributed to dredging maneuvers.

As regards critical species within the AAEA: *Paraclinus fehlmanni* growths its habitat in intertidal zones, i.e. far from the dredged area and the Port Terminal, which will also direct its expansion towards already modified habitats; whereas the *Urobatis tumbesensis* develops in inner canals towards the open sea area of Archipiélago de Jambelí, and its biggest threat is incidental catch. For both species, as well as for the bird *Calidris pusilla*, no adverse impacts are estimated due to the project presence or expansion.

Within the phytoplankton community, there is no evidence whatsoever that could link dredging maneuvers to effects on the community; a noticeable difference in abundance is observed in Estero Santa Rosa samples compared with the offshore samples, yet the differences lessen among the main regions in relation to species richness.

The zooplankton community with fractions larger than 300 and 500 micrometers did not show a clearly defined pattern. Though with regard to the fraction larger than 500 micrometers, a greater abundance was observed in winter, which decreased at the sampling pertaining to the performance of dredging maneuvers, yet showed a new abundance peak after two months in the vicinity of Isla Santa Clara, as well as in Estero Santa Rosa, with the likelihood that the sampling coincided at the dredged sediment basin with tidal changes; the least zooplankton abundances were recorded between August and October, period which corresponds to the summer season of the coast of Ecuador. There is no sufficient evidence to relate said reduction to the dredging maneuvers.

As regards mangrove productivity, bivalves and red crab extraction was measured with standard pedestrian fishing (1 hour). This monitoring procedure showed that the sampling pertaining to the performance of dredging maneuvers would have achieved more abundant collections than in other samplings, thus evidencing that no effect in terms of bivalve abundance can be attributed to these maneuvers. As to the red crab, it would not have been affected by dredging maneuvers. The size (mean shell diameter) of exploited resources is another indicator that allows for determining the absence of effects on resources exploited in a pedestrian manner at regions adjacent to Estero Santa Rosa dredging site; should there be any effects, smaller mean sizes should appear in subsequent samplings, which was not the case.

As regards marine mammals, several encounters with sea lions *Otaria flavescens* have been recorded in the area near Santa Clara. During the offshore monitoring procedure on 7 August 2019, two distant interactions with protected marine beings were witnessed: the first one pertained to a humpback whale *Megaptera novangliae* sighting, a female adult and a calf; the second one, to a pod of 20-30 dolphin individuals *Stenella coeruleoalba* heading northeast through vertex No. 2 of the dredged sediment disposal site towards Isla Puná. During the offshore monitoring procedure on 2 August 2019, whales were observed at a distance from the navigation route heading towards Santa Clara station; a later observation revealed a specimen doing jumps and tail splashes between Santa Clara sampling station and Isla Santa Clara.

6.3 Absence of net reduction in CR and EN species populations

No official quantitative information is available in relation to the historic evolution of endangered or critically endangered resource populations, although on the basis of the analyzed information, and in agreement with the foregoing paragraph, species *Paraclinus fehlmanni, Urobatis tumbesensis* and *Calidris pusilla* will not experience a net population reduction due to the project operations

6.4 Biodiversity monitoring and assessment program

The Environmental and Social Management Plan prepared in the Environmental and Social Impact Assessment of Puerto Bolivar Project Stage 1 includes a monitoring program of marine coastal resources that is broader than the current one and which has been carried out since 2018. Said program includes:

- Invasive species management plan
- Monitoring plan:

  Water quality
  Hydrology
  Sediment quality
  Biotic samplings: Phytoplankton, zooplankton, benthos, Ichthyofauna,
  Marine mammals,
  Samplings in mangrove resources, bioaccumulation in bivalves,

- Stranding management plan

Prevention plan for collisions with whales and other marine mammals. Since there are two species identified as critical for the project, the following practices are proposed within Ichthyofauna monitoring procedures.

Urobatis tumbesensis.

As is the case with all batoidea, such as guitarfish and rays, other fish and invertebrates regarded as vulnerable or protected by the Ecuadorian legislation, every captured specimen, in addition to being recorded, must be measured with an ichthyometer and photographed in detail in order for their identifications to become less common so as to have more data on these species.

A new fishing spot in Estero Santa Rosa should be integrated so as to demonstrate the presence of these beings in the port vicinity.

Paraclinus felhmanni

It lives in intertidal river pools and shallow waters, which requires the inclusion of at least 3 sampling points at intertidal sites: Pongal, Chupadores, Bajo Hediondo and Bajo Gregorio; as well as the review of sectors with ponds in order to confirm the presence of these species and other infauna invertebrates from sandy beaches.

Calidris pusilla

The same site where the monitoring of *Paraclinus felhmanni* is proposed will be subject to the monitoring of birds at resting spots or flocks (while focusing on the presence of *Calidris pusilla* and other birds). Binoculars and high-definition cameras are required for appropriately conducting documentation endeavors.

7. Critical Habitats management plan

7.1 Quantifying gains and losses

As has already been stated throughout this document, the mangrove ecosystem, due to its ecosystem importance and proximity to the Project, is regarded as a Critical Habitat.

The coastal line of project Stage 1 expansion area is populated by small dwarf mangrove patches[16] *Rhizophora mangle,* which have grown in the rockfill walls that protect the coast, and for that reason they lack the conditions for an appropriate development. It was estimated that the surface covering these mangroves is 0.6 hectares. It should be pointed out that since they are isolated, low-vitality trees, they are not subject to exploitation of fishery resources of any kind, and are different from natural formations in that they lack soft sediments.

Even though these mangroves will not be directly affected during Stage 1 since they are left out of the intervention zone, they may be indirectly affected by the change of tidal flow and sediments throughout the operational period.

7.2 Invasive species control

One way in which maritime transport can impact the biodiversity of the area in which it operates is the unintentional transfer of invasive species through water and ballast sediments that vessels load in a sector and then release from another to compensate for weight loss or gain due to the loading and unloading of goods.

[16] Dwarf mangroves are a kind of mangrove formation that develops in regions with inappropriate substrates or a deficient hydrological regime; they are named dwarf since they do not grow as tall as other mangrove species

Ballast water can contain marine species such as bacteria, viruses, protozoa, phytoplankton and some macroscopic species, generally zooplankton as well as human pathogens. Another way of transporting invasive species can be through vessel hull incrustations.

The range of organisms that can survive in a new aquatic environment is narrow. The following factors determine the success of a species transported in ballast water: water temperature range and time frame in which said temperature is favorable, salt tolerance, adequate ecological conditions (habitat, predators, food sources).

Even though Equatorial regions are not classified as Potentially Dangerous Areas (Baro & Stotz, 2018), there are practices that can be followed in order to reduce the risk of exotic species invasion, such as: 1) Verification of compliance with the Ballast Water Report, 2) Verification of ballast water area of origin, 3) Quantify the risk associated with ballast water discharge and check ballast water replacement, all of these procedures are laid down in the International Convention for the Control and Management of Ships' Ballast Water and Sediments of 13 February 2004 (BWM, 2004) promoted by IMO, GEF and UNDP, which is known as the GloBallast Program[17] and was ratified by Ecuador on 8 September 2017.

This convention specifies in several policies the control and monitoring mechanisms for vessel responsibility, as well as for port facilities receiving ballast water during vessel assistance which may be requested by competent authorities, in this case, by the local Jurisdiction Port captain (Grau Avila, 2018)

It should be pointed out that although control mechanisms can be simplified by using sensors, these involve the sampling of vessels' ballast tanks, the power of which is granted exclusively to the local authorities and not to licensees of port infrastructures; besides, verification analysis for phytoplankton and bacterial culture require at least 48 hours to complete, which is why these analyses are limited to the national jurisdiction and may slow down the flow of goods.

7.3 Measures for the Biodiversity Action Plan.

As has already been established in this assessment, the Project and its area of influence are defined within regions identified as Critical Habitats based on their definition in Performance Standard 6 of the IFC. Although it is emphasized that the Project will not produce direct impacts on these habitats, its realization at a specific location must bring tangible benefits associated with its conservation aims via the implementation of a Biodiversity Action Plan. Therefore, a portfolio of supportive initiatives is being contemplated to address the management of AUSCM, RMISC and, in general, the encouragement of conservation management capabilities both in public institutions with subject matter jurisdiction (MAAE and RMISC park rangers) and in social organizations of ancient inhabitants and traditional mangrove users.

[17] http://archive.iwlearn.net/globallast.imo.org/index.html

In order for these initiatives to be successfully applied, other institutions and social organizations, except for No. 1, need to get involved, sign letters of mutual commitment, and agree to work jointly in matters deemed of pressing nature by the parties; therefore, the selection of initiatives to be finally implemented will be performed based on an assessment of feasibility achieved during the initial approaches. Likewise, the estimated cost provided is for reference purposes only, whereas the real value to be conveyed will depend on the definition of issues and aims.

Said initiatives are shown in Table 5.

Table 5 Measures for the Critical Habitats management plan

No.	Initiative	Beneficiaries	Aim	End goal	Duration (years)	Total Cost (USD)	Verification means	Responsible party
1	During biotic, marine and mangrove resource monitoring procedures, demonstration on a differentiated basis of sighting occurrences of critically endangered species within the AAEA: *Paraclinus fehlmanni*, *Urobatis tumbesensis*. *Calidris pusilla.*	--	Knowledge contribution on CR, EN and VU species	Identification of population occurrences of critical species for the project in the AAEA.	Validity of relevant PMA	No additional costs	Monitoring report and photographic record	HSE
2	Raise awareness among YILPORT personnel of Critical Habitats in the Project Area of Indirect Influence (AID) (biannual)	YILPORTECU personnel Aso. Turística San Antonio	Raising personnel awareness	Raising personnel awareness of Critical Habitats	6	15,000.0	Photographic record and visit schedule	HR-HSE
3	Patrolling support and equipment at RMISC (biannual)	MAAE	Strengthening of RMISC safekeeping capabilities	Approximately 13 square miles	6	22,500.0	YILPORT-MAAE cooperation agreement, annual assessment report	Direction
4	Recovery of natural mangrove zonation (reforestation) at Isla del Amor region	Community organization of traditional mangrove users	Increase in mangrove coverage	10 ha	6	47,747.0	Technical specifications and process publications	HSE
5	Financing of the Socio Manglar program for AUSCM in the AID	Community organization of traditional mangrove users	Strengthening of mangrove safekeeping capabilities	467 ha	3	49,211.0	YILPORT-MAAE cooperation agreement - Social Organizations	Direction

No.	Initiative	Beneficiaries	Aim	End goal	Duration (years)	Total Cost (USD)	Verification means	Responsible party
6	Financing of the research project: - Carbon capture in mangroves within the AID -	Grant recipient - University or Research Institute	Strengthening of RMISC safekeeping capabilities	Approximately 13 square miles (7 hectares of land and 2 nautical miles around the isle and islets)	4	48,400.0	YILPORT-MAAE cooperation agreement - transfer certificates, results report	Direction
7	Support institutions with an expertise in marine coastal regions for the determination and tracking (on a five-year basis) of the Mangrove Forest Trend and Condition (ICTBM) within the area of direct influence	Grant recipient - University or Research Institute	Determine and monitor mangrove conditions in the area of direct influence	2,000 ha in the area of direct influence	10	75,000.0	Cooperation agreement YILPORT - institutions, academic journals, technical specifications and/or reports	Direction
8	Support the integration of a “Community Scientific Station” for mangrove monitoring and assessment (biannual): mangrove structure and coverage, carbon stock, species identification	University - Organizations of ancient inhabitants and traditional mangrove users	Mangrove structure monitoring	Up to 4 organizations with AUSCM in the safekeeping area	10	72,000.0	Cooperation agreement YILPORT - institutions, academic journals, technical specifications and/or reports	Direction

8. Bibliographical references

Agreda, A. (2019). Las aves de los manglares del Canal de Jambelí, un vistazo a su diversidad y abundancia. Molina Moreira, N. & Galvis, F. (Comp). Primer Congreso Manglares de América. Universidad Espíritu Santo

Agreda, A. (2017). Plan de Conservación para Aves Playeras en Ecuador. Resumen Ejecutivo. Aves y Conservación / BirdLife en Ecuador, Red Hemisférica de Reservas para Aves Playeras. Quito, Ecuador. Pp. 58.

Alongi D. M., Boto, K.G. and Robertson, A.I. (1992) Nitrogen and phosphorus cycles. In: Robertson AI, Alongi DM (eds) Tropical mangrove ecosystems. (Coastal and estuarine studies 41) AGU, Washington, pp 251–292

Alongi, D. M., Pfitzner, J., Trott, L. A., Tirendi, F., Dixon, P., and Klumpp, D. W. (2005). Rapid sediment accumulation and microbial mineralization in forests of the mangrove Kandelia candel in the Jiulongjiang Estuary, China. Estuarine, Coastal and Shelf Science, 63(4), 605–618. doi:10.1016/j.ecss.2005.01.004

Ball, M.C. and Farquhar C (1984). Photosynthetic and stomatal responses of the grey mangrove, *Avicennia marina*, to transient salinity conditions. Plant Physiology 74: 7-11 pp.

Baro-Narbona, Sandra, & Stotz, Wolfgang. (2018). Propuesta para el control del agua de lastre en buques que arriban a puertos de la Ecorregión Marina de Chile Central. Revista de biología marina y oceanografía, 53(3), 291-306. https://dx.doi.org/10.22370/rbmo.2018.53.3.1355

Beitl, Christine M. 2017, Decentralized mangrove conservation and territorial use rights in Ecuador´s mangrove-associated fisheries. Bulletin of Marine Science, Volume 93, Nuber 1, January 2017. Pp 117-136

Branch, T. A. (2007). Humpback whale abundante Routh of 60ºS from three complete circumpolar sets of surveys. Journal of Cetacean Research Management. Edición especial 25, 12-17.

Bunt, J. S. (1992) How can fragile ecosystems best be conserved?. In: Hsü KJ, Thiede J (eds) Use and misuse of the seafloor. (Dahlem workshop reports: environmental science research report 11) Wiley, Chichester, pp 229–242

Carrillo, E., S. Aldás, M. Altamirano, F. Ayala, D. Cisneros, A. Endara, C. Márquez, M. Morales, F. Nogales, P. Salvador, M. L. Torres, J. Valencia, F. Villamarín, M. Yánez, P. Zárate. 2005. Lista Roja de los Reptiles del Ecuador. Fundación Novum Milenium , UICN-Sur, UICN-Comité Ecuatoriano, Ministerio de Educación y Cultura. Serie Proyecto PEEPE. Quito.

Carvajal, R., Saavedra,M., Alava, J.J. Ecología poblacional, distribución y estudio de hábitat de Crocodylus acutus (Cuvier, 1807) en la "Reserva de producción de fauna manglares El Salado" del estuario del Golfo de Guayaquil, Ecuador Revista de Biología Marina y

Oceanografía, vol. 40, núm. 2, diciembre, 2005, pp. 141-150, Universidad de Valparaíso Chile.

Carvajal R. and X. Santillán. (2019). Plan de Acción Nacional para la Conservación de los Manglares del Ecuador Continental. Ministerio del Ambiente de Ecuador, Conservación Internacional Ecuador, Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (UNESCO) y la Comisión Permanente del Pacífico Sur (CPPS). Proyecto Conservación de Manglar en el Pacífico Este Tropical. Guayaquil, Ecuador

Contreras, F., Bartheld, J., Montecinos, M., Moreno F. & Torres, J., 2014. Cuantificación poblacional de lobo marino común (Otaria flavescens) en el litoral de la XV, I y II Regiones. Informe Final Proyecto 2012-6-FAP-1, 86 pp + Anexos. *(9) (PDF) Cuantificación poblacional del lobo marino común (Otaria flavescens) en el litoral de la XV, I y II Regiones 2012*. Available from: https://www.researchgate.net/publication/278713906_Cuantificacion_poblacional_del_lobo_marino_comun_Otaria_flavescens_en_el_litoral_de_la_XV_I_y_II_Regiones_2012 [accessed May 26 2021].

Critical Ecosystem Partnership Fund CEPF (2005). Perfil de ecosistema: Corredor de Conservación Choco-Manabi Ecorregión terrestre Prioritaria del Choco Darién -Ecuador Occidental (HOTSPOT) Colombia y Ecuador. epf.net/sites/default/files/final.spanish.choco-darien-western-ecuador.choco_.ep_.pdf

Convención de Ramsar sobre los Humedales. (2018). Perspectiva mundial sobre los humedales: Estado de los humedales del mundo y sus servicios a las personas. Gland (Suiza). Secretaría de la Convención de Ramsar.

Defeo Omar (2018). Ecología de Playas arenosas: tendencias y perspectivas. Facultad de ciencias, Unidad de ciencias del Mar, Universidad de la Republica del Uruguay. http://jornadasdelmar2018.exactas.uba.ar/wp-content/uploads/2018/08/Defeo_XJNCM_2018.pdf

De Groot, R., Brander, L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., Ten Brink, P. and P. Van Beukering (2012). Global estimates of the value of ecosystems and their services in monetary units. Ecosystems services 1 (2012)50-61. http://dx.doi.org/10.1016/j.ecoserv.2012.07.005.

Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M. and M. Kanninen (2011). Mangroves among the most carbon-rich forest in the tropics. Nature Geosciences Letters doi:10.1038/NGEO1123

Duke, N.C., Meynecke, J. O. S., Dittmann, A.M., Ellison, K., Anger, U., Berguer, S., Cannicci, K., Diele, K.C., Ewel, C.D., Field, N., Koedman, S.Y., Lee, C., Marchand, I., Nordhaus, F. and Dahdouh-Guebas. (2007). A World without Mangroves? Science, 317(5834),41b-42b. letter doi:10.1126/science.317.5834.41b

Ellison, A.M. (2008). Managing mangroves with benthic diversity in mind: Moving beyond roving banditry. Journal of Sea Research 59(2008)2-15.

doi:10.1016/j.seares.2007.05.003

Espinosa, C.I., De la Cruz 2, M., Luzuriaga, A.M., Escudero, A. (2012). Bosques tropicales secos de la región Pacífico Ecuatorial: diversidad, estructura, funcionamiento e implicaciones para la conservación. Ecosistemas 21 (1-2): 167-179. Enero-Agosto 2012.

FAO (2007) The world's mangroves 1980–2005. FAO Forestry Paper. FAO, Rome, Italy

FitzGerald D.M., Fenster M.S., Argow B.A., Buynevich I.V. (2008). Coastal impacts due to sea-level rise. Annual Review of earth and planetary Sciences 36:601–47

Flores-Aguilar, D. et al. (2020). Análisis multitemporal de la superficie ocupada por la cría de camarón (Litopenaeus vannamei) en los manglares del archipiélago de Jambelí. Bosques Latitud Cero,10(2),146-160.

Froese,R. and D.Pauly. Editors. 2021. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2021).

Furukawa, K., and Wolanski, E., 1996. Sedimentation in mangrove forests. Mangroves and Salt Marshes 1, 3–10.

Furukawa, K., Wolanski, E., Mueller, H., 1997. Currents and sediment transport in mangrove forest. Estuarine Coastal and Shelf Science 44, 301–310.

GBIF.org (14 May 2021) GBIF Occurrence Download https://doi.org/10.15468/dl.grb8py

Grau Avila Maria (2018). Desafíos para el Estado ecuatoriano frente al cumplimiento de los compromisos internacionales en materia de gestión y control de las aguas de lastre y sedimentos de los buques. Proyecto de investigación para Optar al Título de Abogado de los Juzgados y Tribunales de la Republica. Universidad laica Vicente Rocafuerte de Guayaquil Facultad de Ciencias Sociales y Derecho, Carrera de Derecho.

Giri, C., Ochieng, E., Tieszen, L.L., Zhu, Z., Singh, A., Loveland, T. J. & Masek and Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. Global Ecology and Biogeography, 20(1), 154–159. https://doi.org/10.1111/j.1466-8238.2010.00584.x

Hamilton L.S. and Snedaker, S.C. (1984). Handbook for Mangrove Area Management. East West Center, Environment and Policy Institute, UNESCO, IUCN and UNEP ,140 pp.

Hamilton, S. E., and Casey, D. (2016). Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century (CGMFC-21), 729–738. https://doi.org/10.1111/geb.12449

Hamilton, S.E. (2019). Mangroves and Aquaculture. A five-decade remote Sensing Analysis of Ecuador´s Estuarine environments. Coastal Research Library 33. ISBN 978-3-030-22240-6. https://www.springer.com/gp/book/9783030222390

Holguin, G., Vazquez, P., & Bashan, Y. (2001). The role of sediment microorganisms in the productivity, conservation, and rehabilitation of mangrove ecosystems: an overview. Biology and Fertility of Soils, 33(4), 265–278. doi:10.1007/s003740000319

Hutchings P. and Saenger P. (1987). Ecology of Mangroves. Brisbane: University of Queensland Press.388pp.

Hutchison, J., Spalding, M. and Ermgassen, Z. P. (2014) The Role of Mangroves in Fisheries Enhancement. The Nature Conservancy and Wetlands International. 54 pages

IBAT Expansión Puerto Bolívar - Fase 1 Report, 2021. Generated under license number 7188-15846 from the Integrated Biodiversity Assessment Tool on 21/04/2021. http://www.ibat-alliance.org

IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-1. https://www.iucnredlist.org. Downloaded on [23/04/2021].

Jacome de Solorzano y Llanos (1987). Estudio geoquimico de los sedimentos en el canal de Jambeli. Acta oceanografica del pacifico INOCAR Ecuador 4(1). pp 191-203.

Jennerjahn, T. C., & Ittekkot, V. (2002). Relevance of mangroves for the production and deposition of organic matter along tropical continental margins. Naturwissenschaften, 89(1), 23–30. doi:10.1007/s00114-001-0283-x

Krauss K.W., McKee K.L., Lovelock C.E., Cahoon D.R., Saintilan N., Reef, R. and L. Chen (2013). How mangrove forests adjust to rising sea level. New Phytologist. 202:19–34

Latorre, S. (2014). Resisting Environmental Dispossession in Ecuador: Whom Does the Political Category of “Ancestral Peoples of the Mangrove Ecosystem” Include and Aim to Empower? Journal of Agrarian Change, n/a–n/a. doi:10.1111/joac.12052

Lindsey R. (2009). Sea level since 1880. Climate Change: Global sea level. Climate.gov. science & information for a climate-smart nation. https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level

Loza, M.I., Moraes, M and P.M. Jorgensen (2010). Variación de la diversidad y composición florística en relación a la elevación en un bosque montano boliviano (PNANMI Madidi). Ecología en Bolivia 45(2) 87-100

MAE. Ministerio del Ambiente (2017) http://www.ambiente.gob.ec/ proyecto-regularización-de- camaroneras/. Acceso 23 Mayo 2017

MAE. Ministerio del Ambiente (2004). Policies and Strategic Plan of Ecuador’s National System of Protected Areas 2007-2016

MacKenzie, R.A., Foulk, P.B., Val Klump, J., Weckerly, K., Purbospito, J., Murdiyarso, D., Donato, D.C. and Nam, V.N. (2016). Sedimentation and belowground carbon accumulation rates in mangrove forest that differ in diversity and land use: a tale of two mangroves. Wetlands ecology and management. 24: 245-261. DOI 10.1007/sl1273-016-9481-3

Ocampo-Thomason, P. (2006). Mangroves, people and cockles: Impacts of the shrimp-farming industry on mangrove communities in Esmeraldas Province, Ecuador. In Environment and Livelihoods in Tropical Coastal Zones: Managing Agriculture-Fishery-Aquaculture Conflicts (pp. 140–153). CABI Publishing.

Ofosu-Asiedu, A. (s.f.). El intercambio de experiencias y situación del conocimiento sobre la ordenación forestal sostenible de los bosques tropicales húmidos. Obtenido de http://www.cich.org/publicaciones/09/Ofosu.pdf

Orihuela-Torres, A.; López-Rodríguez, F. y OrdoñezDelgado, L. (2016). 50 aves comunes del Archipiélago de Jambelí. Grupo de Investigación: Gobernanza, Biodiversidad y Áreas Protegidas. Universidad Técnica Particular de Loja.

Paw, N.J. & Chaw, T.E. (1991). An Assessment of the ecological and economic impact of mangrove conversion in Southeast Asia. Towards an integrated management of tropical coastal resources. ICLARM. Conference Proceedings 22:201-212.

Phan, N.H., J.S.M Van Thiel De Vries and M.J.S. Stive (2015). Coastal mangrove squeeze in the Mekong Delta. J. Coast. Res 31: 233-43

Pontificia Universidad Católica del Ecuador. 2021. Base de datos de la colección de reptiles del Museo de Zoología QCAZ. Versión 2021.0. Disponible en <https://bioweb.bio/portal/> Consulta: 26 de mayo 2021.

Rada F. (1986). Morfologia y sedimentacion del Sistema Estuario Salado-Rio Guayas. Acta Oceanografica del pacifico Vol. III N°1.-Enero 1978 pp 36-39.

Rodríguez F.V., (2018) Mangrove Concessions: An Innovative Strategy for Community Mangrove Conservation in Ecuador. In: Makowski C., Finkl C. (eds) Threats to Mangrove Forests. Coastal Research Library, vol 25. Springer, Cham

Sanderman, J., Hengl, T., Fiske, G., Solvik, K., Adame, M. F., Benson, L., Bukoski, J., Carnell, P., Cifuentes Jara, M., Donato, D., Duncan, C., Eid, E., Ermgassen, P., Ewers Lewis, C., Macreadie, P., Glass, L., Gress, S., Jardine, S., Jones, T., Nsombo, E., Rahman, Md., Sanders, C., Spalding, M and Landis, E. (2018). A global map of mangrove forest soil carbon at 30 m spatial resolution. Environmental Research Letters, 13, 55002. https://doi.org/10.1088/1748-9326/aabe1c

Shahbudin, S., Mohd Lokman, H., Rosnan, Y. and Toshiyuki, A. (1999). Sediment accretion and variability of sedimentological characteristics of a tropical estuarine mangrove: Kemaman, Terengganu, Malaysia. Mangroves and saltmarshes, 3: 51-58.

Smith T.J. III. 1987. Seed predation in relation to tree dominance and distribution in mangrove forests. Ecology 68:266–73

Snedekar, S. C. and Brown, M. S. (1981). Water quality and mangrove ecosystem dynamics. EPA Res. Dev. EPA 600/S4.

Spalding, M., Kainuma, M. and Collins, L. (2010). World Atlas of Mangroves. ITTO, ISME, FAO, UNEP-WCMC, UNESCO-MAB and UNU-INWEH. Earthscan Publishers Ltd. London

Spalding MD, Agostini VN, Rice J, Grant SM (2012). Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters. Ocean and Coastal Management 60: 19-30. DOI: 10.1016/j.ocecoaman.2011.12.016.

Data URL: http://data.unep-wcmc.org/datasets/38

Tapia, F. (2017). Recuperación del estero Huaylá en la ciudad de Machala – Ecuador, mediante backcasting participativo. INSTITUTO DE SOSTENIBILIDAD - UNIVERSITAT POLITÈCNICA DE CATALUNYA. From http://hdl.handle.net/2117/108680

Tomlinsom P.B. (1986). The boyany of Mangroves. New York: Cambridge University Press

Van Lavieren, H., Spalding, M., Alongi, D. M., Kainuma, M., Clüsener-Godt, M., Adeel, Z., and Benedetti, L. (2012). Securing the Future of Mangroves. A Policy Brief to the United Nations - Institute for Water, Environment and Health, *53*. Retrieved from http://www.inweh.unu.edu

Vera Leonor (2004). Estudio del nivel medio del mar en Puerto Bolívar. Acta Oceanografica del Pacifico Vol. 12(1), 2003-2004.

Veuthey, S., and Gerber, J.-F. (2012). Accumulation by dispossession in coastal Ecuador: Shrimp farming, local resistance and the gender structure of mobilizations. Global Environmental Change, 22(3), 611–622. doi:10.1016/j.gloenvcha.2011.10.010

Richard J. Weller, "Précis" in Richard J. Weller, Claire Hoch, and Chieh Huang, Atlas for the End of the World (2017), http://atlas-for-the-end-of-the-world.com.

Yanez-Arancibia, A., Lara-Dominguez, A.L.; Rojas-Galaviz, J.L.; Sanchez-Gil, P.; Day, J.W. and Madden, C.J. (1988). Seasonal biomass and diversity of estuarine fishes coupled with tropical habitat heterogeneity (southern Gulf of Mexico). Journal of Fish Biology, 33 (Suppl.a)191-200

Wolanski, E., Mazda, Y., Ridd, P. (1992). Mangrove hydrodynamics. In: Robertson, A.I., Alongi, D.M. (Eds.), Coastal and Estuarine Studies. American Geophysical Union, p.329

9. Annexes

Annex 1. Puerto Bolívar Expansion - Stage 1 IBAT Report

Annex 2. Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) on herbaceous species

Annex 3. Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) on marine birds

Annex 4. Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) on included fish

4.a. Chondrichthyes or Elasmobranchii
4.b. Actinopterygii

Annex 5. Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) on reported aquatic invertebrates

Annex 6. Puerto Bolívar Expansion - Stage 1 IBAT Report (2021) on marine mammals and reptiles

Annex 7. CR/EN species in the project area

Annex 8. Species occurrences in the Project area of influence. GBIF Occurrence Download

Annex 9. Migratory species recorded for Ecuador pursuant to the CMS

Annex 10. Final report of the research project bearing Authorization No. 002-2019-IC-FLORA/FAUNA-DPAEO-MAE: wildlife species specimen collection for conducting environmental assessments and other instruments for environmental regularization

Annex 11. Species identified in monitoring procedures at Puerto Bolívar

I, Miguel Angel Pantoja Shimanskii, certify that the present document consisting of 51 pages in english was translated from its original version in spanish, it's accurate to the best of my capacities as a Sworn Court Certified Translator of the Judicial Council of Ecuador.

Yo, Miguel Angel Pantoja Shimanskii certifico que el presente documento que consta de 51 páginas en ingles fueron traducidas de su versión original en español, son precisas en mis capacidades como traductor calificado y jurado del Consejo de la Judicatura.

Nombre/ Name: Miguel Angel Pantoja Shimanskii
CC/National ID #:1717206534

Fecha/Date: 13 de Junio 2021 / June 31, 2021
Número de calificación/ Qualification number: 1840315
Correo electrónico/email: m.pantoja@translatorsecuador.com
Tel: +593. 999946572

Note/Nota: You can verify credentials inputting National ID# on the following link:

Verifique las credenciales ingresando la CC en el siguiente link:
https://appsj.funcionjudicial.gob.ec/perito-web/pages/peritos_nacional.jsf

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PUERTO BOLIVAR PROJECT PHASE 1

– SOCIAL BASELINE–

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Elaborated by:

ECOSAMBITO C. LTDA.

December 2020

Table of Contents

Index of Tables

Index of Figures

EXECUTIVE SUMMARY

In order to understand social actors in the influence area of the Project, a primary and secondary information survey was performed by applying tools such as enquiries to inhabitants and union representatives, semi-structured interviews to union leaders, and analysis and synthesis of secondary information.

According to IFC development standards, knowing community perception and participation regarding activities performed as part of the project is an important aspect. Specifically, ND1 that considers much more developed aspects regarding community relations and other social actors establishing more solid and profound relationships. Therefore, acknowledging current situation in order to complement measures and programs proposed by the Environmental and Social Management Plan (ESMP, PGAS in Spanish) into their reality is a way to guarantee their compliance.

This document presents a social baseline that establishes the conditions of education, health, housing, and basic services of the population closest to the project, as well as their productive activities, perceptions, and expectations regarding the construction and operation of the project.

Stakeholders have been identified and mapped in order to define communication and outreach strategies in the short, medium and long term.

Finally, an assessment of the potential risks and impacts of project activities on the health and safety of the community has been carried out.

SOCIAL BASELINE

1. Introduction

Consultancy retained for "SOCIAL AND EVIRONMENTAL ASSESSMENT FOR PUERTO BOLIVAR PORT TERMINAL PHASE 1 - YILPORT TERMINAL OPERATIONS" Project includes a diagnostic study about socio-economical characteristics and a socio-economic survey that should contain indicators such as population ethnic characteristics, gender and socioeconomic status, utilities, and infrastructure in compliance with valid national standards and International Finance Corporation (IFC) performance standards

2. Justification

Due to COVID 19 pandemic, performing personal or direct survey was limited. However, this type of survey was implemented by taking into account biosafety protocols and physical and social distancing.

3. Methodology

In order to collect and analyze data for "ENVIRONMENTAL AND SOCIAL ASSESSMENT FOR PUERTO BOLIVAR PORT TERMINAL PHASE 1 - YILPORT TERMINAL OPERATIONS - YILPORTECU S.A." Project, a deductive methodology in El Oro Province (macro level) and Machala Canton (micro level) was used, since Puerto Bolivar District is specifically considered as a urban district in Machala Canton.

A primary information survey through closed enquiries including multiple choice and single selection questions was performed. This tool will provide results with rough data representing an actual and updated social diagnosis.

Methodological tools were:

- A first-level analysis involved literature review (publications, reports, audits and previous environmental impact studies, Machala Canton 2018 Development and Land Use Plan (PDOT in Spanish) for the study area.
- A second level involves primary information by implementing physical enquiries.

3.1. Enquiry Implementation Procedure

Face-to-face enquiries were performed in Puerto Bolivar urban district. The form used in these enquiries is presented in Appendix 1.

Sample Selection

Object population in this enquiry is obtained from 2020 Election Registry prepared by National Election Council, which states that Puerto Bolivar District has 23,062 electors. This number was considered as total universe to obtain an enquiry sample.

Figure 1 Number of electors in Machala Canton and Puerto Bolívar District

CANTÓN PARROQUIA	ÁREA*	ELECTORES	SEXO		TIPO DE VOTO		PERSONAS CON DISCAPACIDAD	JUNTAS	RECINTOS ELECTORALES
			HOMBRES	MUJERES	OBLIGATORIO	FACULTATIVO			
HUALTACO	U	915	438	477	761	154	23	4	1
HUAQUILLAS	U	32.745	16.549	16.196	26.692	6.053	798	99	6
MILTON REYES	U	873	447	426	714	159	24	4	1
UNIÓN LOJANA	U	2.118	1.002	1.116	1.782	336	60	7	1
LAS LAJAS		**4.987**	**2.691**	**2.296**	**3.702**	**1.285**	**261**	**21**	**7**
EL PARAÍSO	R	589	309	280	466	123	32	4	2
LA LIBERTAD	R	685	371	314	517	168	34	4	2
LA VICTORIA/LAS LAJAS	U	2.774	1.517	1.257	2.041	733	143	9	1
PLATANILLOS	U	433	214	219	301	132	26	2	1
SAN ISIDRO	R	506	280	226	377	129	26	2	1
MACHALA		**213.650**	**107.741**	**105.909**	**174.299**	**39.351**	**6.014**	**663**	**52**
9 DE MAYO	U	4.987	2.342	2.645	4.046	941	171	19	3
EL CAMBIO	U	7.063	3.655	3.408	5.654	1.409	193	23	3
EL RETIRO	R	1.947	1.031	916	1.639	308	53	10	3
JAMBELÍ	U	4.364	1.955	2.409	3.616	748	177	14	2
JUBONES	U	1.726	772	954	1.425	301	86	6	1
LA PROVIDENCIA	U	71.756	36.278	35.478	61.764	9.992	2.088	219	19
MACHALA	U	98.745	49.914	48.831	77.379	21.366	2.575	302	16
PUERTO BOLÍVAR	U	23.062	11.794	11.268	18.776	4.286	671	70	5
MARCABELÍ		**5.409**	**2.845**	**2.564**	**4.138**	**1.271**	**199**	**18**	**2**
EL INGENIO	R	301	170	131	225	76	5	2	1
MARCABELÍ	U	5.108	2.675	2.433	3.913	1.195	194	16	1
PASAJE		**66.170**	**33.929**	**32.241**	**52.607**	**13.563**	**2.030**	**218**	**25**
BOLIVAR	U	684	311	373	611	73	18	2	1
BUENAVISTA	R	4.992	2.672	2.320	3.963	1.029	164	15	1

*U= ÁREA URBANA I R= ÁREA RURAL

SIGUIENTE ▶

Canton, Parish, Sex, Men, Women, Vote Type, Compulsory, Optional, Disabled person, Committees, Electoral premises, Urban Area, Rural Area

A formula proposed by Murray & Larry (2005) was used:

$$n = \frac{Z^2 \sigma^2 N}{e^2 (N-1) + Z^2 \sigma^2}$$

Where:

n = is the size of the sample to be obtained.

N = is the size of the Universe. (in this case, 23,062 people registered as electors in Puerto Bolivar urban district)

σ = represents population standard deviation. In case this data is ignored, a constant value equivalent to 0.5 is commonly used.

Z = is the value obtained through levels of reliability. Its value is a constant; generally two values are available, depending on reliability degree required, being 99% the highest value (this value is equivalent to 2.58) and 95% (1.96) the minimum value accepted to consider this investigation as reliable (in this case, 1.96 is the value used).

e = represents the minimum acceptable sampling error, generally from 1% (0.01) to 10%

(0.10), being 5% (0.05) the standard value used during investigations (in this case, 0.10 is used)

Once proper values are established, value substitution and formula implementation to obtain the size of population sample consistent with determined finite universe are performed.

A sample of 96 cases that represents the number of enquiries to be performed in Puerto Bolivia urban district was obtained.

<u>Training to Interviewers</u>

Training to interviewers was performed by explaining in detail the way to fill in the enquiry forms and the biosafety protocols to follow. For this purpose, corresponding PPE (Personal Protection Equipment), biosafety equipment and credentials were delivered.

<u>Material</u>

The following material was used:

- Identification Credential of the Interviewer
- Biosafety Protocol and Physical and Social Distancing
- PPE - Personal Protection Equipment
- Designed and printed enquiry to be applied in a face-to-face manner
- Registry Log of enquiries performed

<u>Biosafety Protocol for field survey approved by National Emergency Operative Center (COE in Spanish)</u>

Personnel for information collection (field survey) will follow biosafety protocols and consider the following:

- Using the following Personal Protection Equipment (PPE): protective suit, hat, and face masks during the whole process, as well as facial protection, glasses and others according to risk exposure for the interviewer.

  Wearing jewelry such as rings, earrings, necklaces or bracelets is prohibited. Carrying personal cleaning kit: alcohol or sanitizer for personal use, and washing and disinfecting hands at least every 3 hours must be performed.
- People having long hair (longer than shoulders) should keep it tied back; finger nails must be kept short.
- When using cellphone, clean it periodically with alcohol applied with a napkin or cloth.
- Physical greeting is prohibited.
- Documentation will be collected at the door of every home/industry/store keeping a 2-meter distancing.
- Disinfecting tools to be used for survey after every enquiry.
- Maximum time per enquiry: 20 minutes.
- Once enquiry is finished, personnel will use sanitizer to disinfect their hands.

Safety during Mobilization

- Using face mask all the time is compulsory.
- A single person per row in small vehicles and keeping distance among passengers.
- In case of vehicles with greater capacity (bus, van) units must apply disinfection process, as established in Cleaning and Disinfection Protocol for Public Transportation Units issued by National Traffic Agency.
- Hand cleaning and disinfection before and after using means of transportation is compulsory.

Adverse Conditions for Enquiry

- People who show symptoms (cough, fever, hard time breathing) that could be related to COVID 19.
- People who are part of a Prioritized Assistance Group: handicapped, old aged, pregnant or having had previous or catastrophic medical conditions such as artery hypertension, heart disease, diabetes, chronic lung disease or immunosuppression, among others.

4. Demography

4.1. Population

According to 2010 Census, El Oro Province has a total population of 600,659 inhabitants: 304,362 men and 296,297 are women.

Population in cantons of El Oro Province is distributed the following manner:

Table 1. Population of cantons in El Oro Province

CANTON NAME	INHABITANT NUMBER
MACHALA	245,972
ARENILLAS	26,844
ATAHUALPA	5,833
BALSAS	6,861
CHILLA	2,484
EL GUABO	50,009
HUAQUILLAS	48,285
MARCABELI	5,450
PASAJE	72,806
PINAS	25,988
PORTOVELO	12,200
SANTA ROSA	69,036
ZARUMA	24,097
LAS LAJAS	4,794

Source: INEC, 2010 Population and Housing Census

Prepared by: *Ecosambito, 2020*.

The canton with the largest number of inhabitants is Machala, taking into account that it is the provincial capital and has highly populated urban districts. It has 245,972 inhabitants: 122,948 women and 123,024 men.

This is, 50.02% of Machala population is comprised by men and 49.98% are women. A minimal difference of 0.04%, corresponds to 76 men more than women[1].

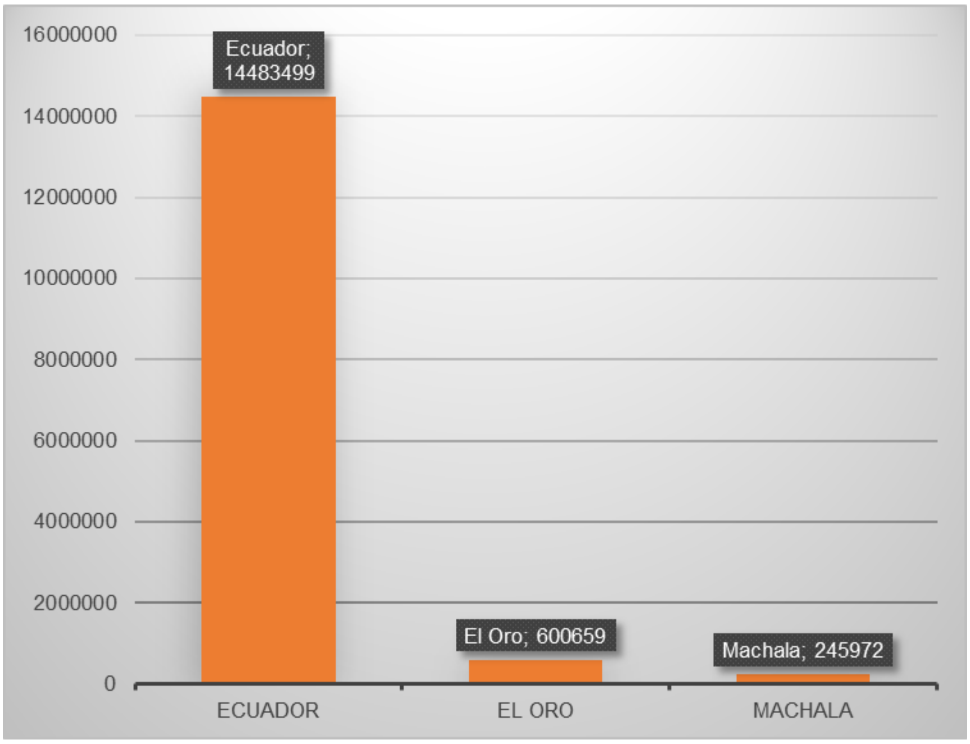
Table 2. Population by Gender according to Canton, Province and Country

CANTON/ PROVINCE/COUNTRY	POPULATI ON	MEN (%)	WOMEN (%)
MACHALA CANTON	245,972	50.02	**49.98**
PROVINCE	600,659	50.67	**49.33**
COUNTRY	**14,483,499**	**49.56**	**50.4**

Source: INEC, Population & Housing Census 2010.

Elaborated by: Ecosambito, 2020.

Figure 2. *Population in territorial jurisdictions*



Elaborated by: Ecosambito, 2020.

Population in Puerto Bolivar District includes 6,174 people: 3,235 men and 2,939 women according to 2010 Census.

[1] National Statistics and Census Institute (INEC), 2010 Population and Housing Census

In El Oro Province, according to five-year age groups, 10.51% people are less than 14 years old, which determines that majority of population are young and no significant differences between men and women are present.

From 15 years old, individuals are present in the pyramid, most of all between 25 and 30 years of age. This phenomenon could be justified because this group leaves the province for study, work and other purposes.

According to large age groups, Machala Canton population is distributed as follows:

- 72,219 inhabitants between 0 and 14 years of age
- 160,321 inhabitants in Machala are in ages between 15 and 64 years old
- 13,432 are 65 years of age or older

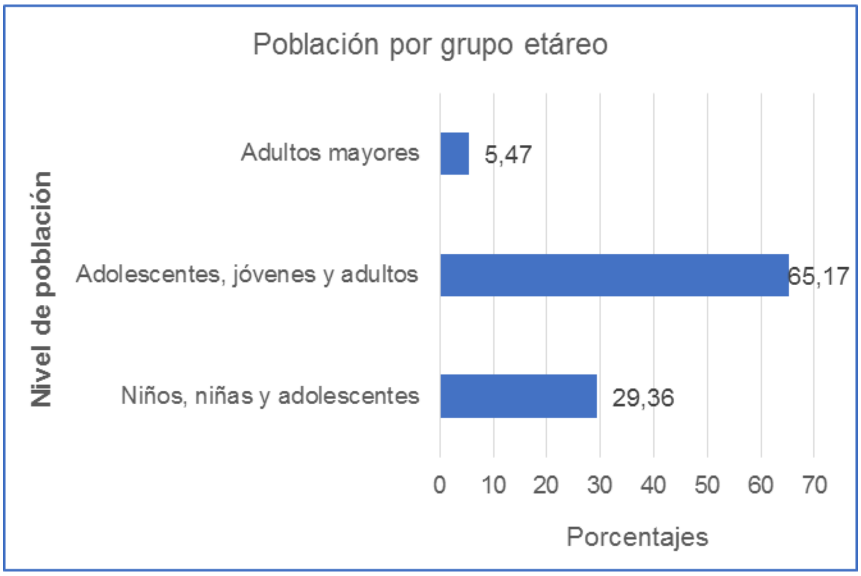
Table 3. *Population by Gender and large age groups in Machala Canton*

Age Groups	Total	%
Children (0/14 years old)	72,219	29.36
Adolescents (12/17 years old), Youngsters (18/28 years old), Adults (29/64 years old)	160,312	65.17
Older Adults (65 and older)	13,432	5.47
TOTAL	**245,972**	**100**

Source: INEC, 2010 Population and Housing Census

Elaborated by: Ecosambito, 2020.

Figure 3. *Population by Age Group*



Age group population, Population level, Senior citizens, Adolescents, youngster, male children, female children and adolescents

Elaborated by: Ecosambito, 2020.

4.1.1. 2010-2020 Population Growth Index

Population projection estimated in Machala Canton refers to demographic data and methodology developed in the study by National Planning and Development Secretariat[2]. In this regard, population estimation refers to:

> […] the number of people estimated an area has or had in a specific moment in time, either globally or by a more reduced category. Such volume is not produced by direct measurement, but in order to obtain this, some information about population has been taken into account […][3]

Population estimation provides a projection:

> […] resulting from a set of demographic, mathematical or any other kind of estimation, by which more plausible trends for determining variables in population dynamics are sought to be established and therefore derivation of population volumes […].[4]

According to methodology established by INEC (2012), a basic principle is to break down population growth into fundamental demographic components. This model enables inferences on a regional, provincial and cantonal basis.

According to this methodology and data provided by INEC, the following figures are presented on a scale related to Machala Canton:

Table 4. *Population Projection for 2010-2020 Period – Machala Canton.*

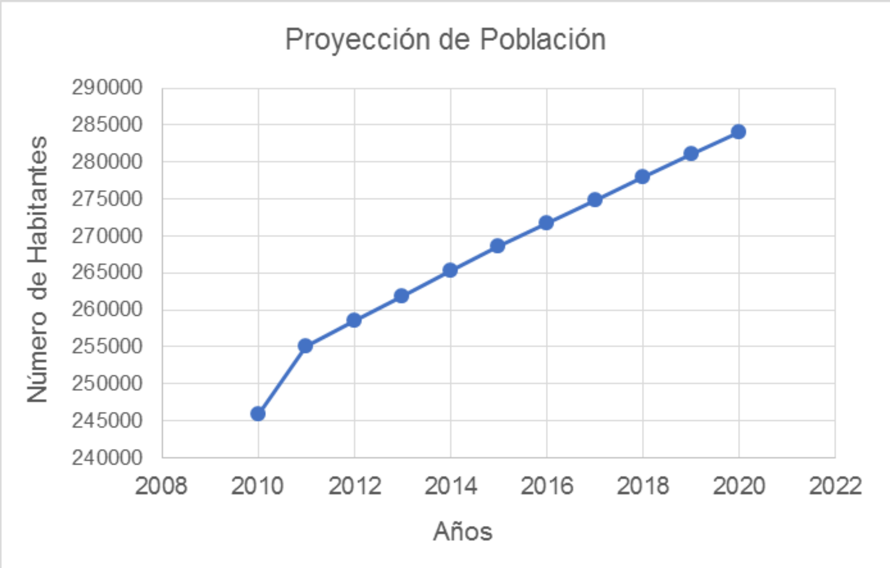
Projection Year	Population
2010	245,972
2011	255,012
2012	258,490
2013	261,905
2014	265,254
2015	268,537
2016	271,758
2017	274,919
2018	278,013
2019	281,041
2020	284,009

Source: INEC 2012 Projections; Census 2010

Elaborated by: Ecosambito, 2020.

[2] INEC (2012) - 2010-2050 Projections for Population in the Republic of Ecuador, SENPLADES Department of Standards and Methodologies, Quito
[3] INEC (2012) *Op. Cit.*
[4] INEC (2012) 2010-2050 Projections for Population in the Republic of Ecuador, SENPLADES Department of Standards and Methodologies, Quito

Figure 4. *Projection for Machala Canton Population*



Elaborated by: Ecosambito, 2020.

4.1.2. Population Density

INEC provides population census data and area of each jurisdiction, in an official manner. This information is used to estimate population density for Machala Canton (including Puerto Bolivar urban district).

Table 5. *Cantonal Population Density*

Districts	Population	Square Km	Population Density
Machala Canton	245,972	33,018	**7.44**

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

5. Ethnic Self-identification

Resulting data from 2010 Population & Housing Census revealed that El Oro Province citizens identified themselves as mestizo (81,78%), being majority, whereas minority, 7,81%, consider themselves as white. A total of 4,81% consider themselves Afro-Ecuadorian, 2,81% Montubio, 2,11% mulatto and only 0,68% indigenous, as shown in the following table:

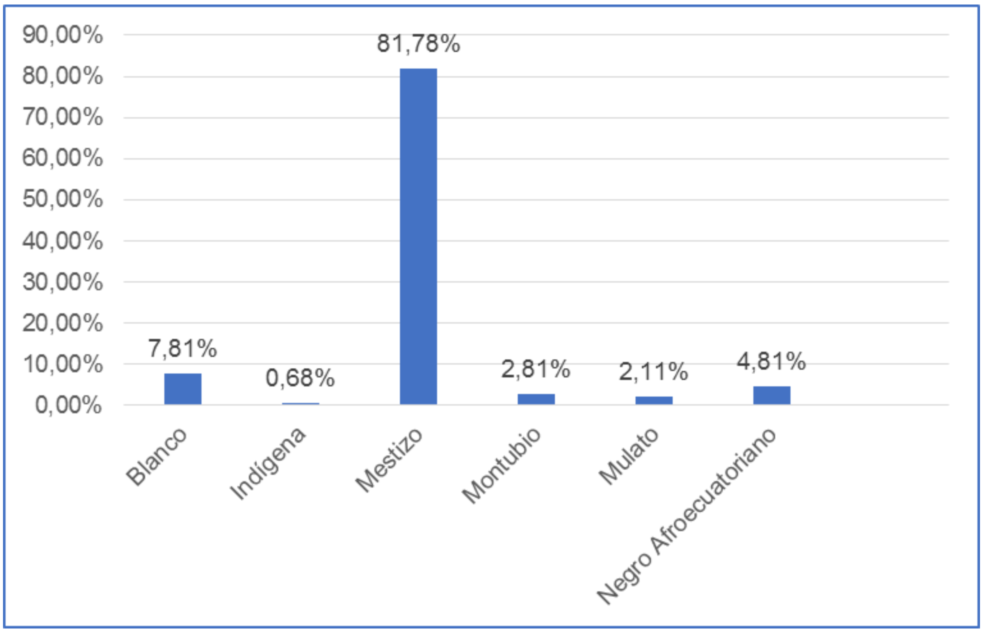
Table 6. *Ethnic Self-identification in El Oro Province*

Indicator	Population	Percentage
White	46,801	7.81
Indigenous	4,060	0.68
Mestizo	489,843	81.78
Montubio	16,858	2.81
Mulatto	12,613	2.11
Afro-Ecuadorian	28,828	4.81
TOTAL	**599,003**	**100.00%**

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

Figure 5. *Ethnic Self-identification in El Oro Province*



Elaborated by: Ecosambito, 2020

According to the seventh population census, mestizo race prevails in Machala Canton, according to people's self-identification, 79% of mestizo people are predominant while 9% of Machala population consider themselves as white, 5% Afro-Ecuadorian; 3% mulatto, 3% Montubio and only 1% state being be indigenous.

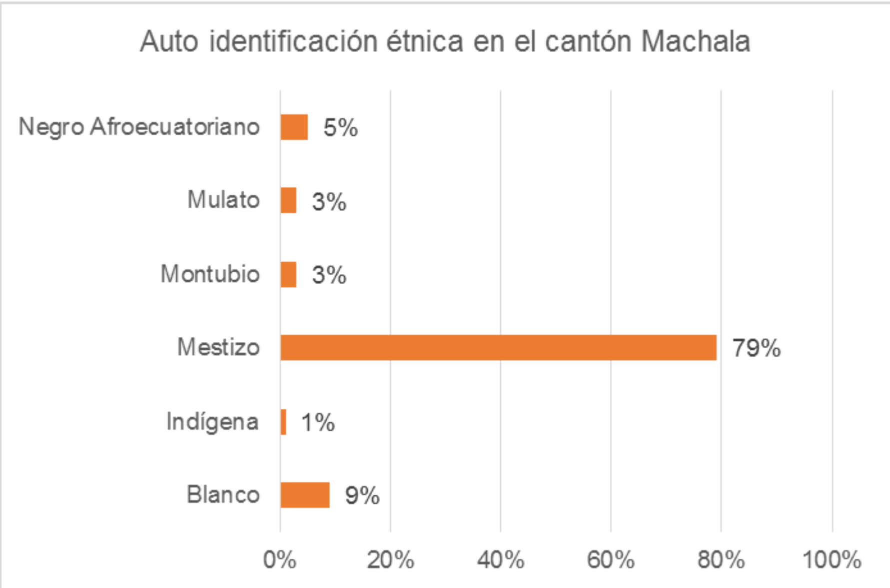
Table 7. *Ethnic Self-Identification in Machala Canton*

Self-Identification	Percentage
Indigenous	1%
Afro-Ecuadorian	5%
Montubio	3%
Mulatto	3%
Mestizo	79%
White	9%
Total	100%

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

Figure 6. *Ethnic Self-Identifcation in Machala Canton*



Elaborated by: Ecosambito, 2020.

6. Economic Activities

6.1. Economic Activity in El Oro Province

In 2010, agriculture, livestock, forestry and fishing sector represented an employment source for 61,592 people living in the province; this is more than one fourth of the economically active population (PEA in Spanish).

This sector is still characterized by a very relevant masculinization since 9 out of 10 active people are men. On the other hand, almost half of active population, 65 years or older, in the Province (46%), belong to such sector.

In El Oro Province, a total of 15,061 economically active people (6%) are concentrated in the secondary sector of provincial PEA. In this province, 4,062 men and 1274 women between 15 and 29 years of age are concentrated in the secondary economic sector and represent 7% of PEA regarding economically active provincial population from 15 to 29 years of age.

In El Oro, 144,516 economically active people located in 2010 service section were registered. In commercial sector 35%, construction 11% and “transportation and storage” 9% sectors are registered”[5].

In El Oro Province, 48% of men and 69% of women between 15 and 29 years of age are concentrated in the tertiary economic sector regarding economically active population ranging 15 and 29 years of age.

Trading activities, including 50,792 people, have increased twice regarding active population in only two decades; it groups 20% of El Oro population. Furthermore, trading sector plays an important role in women incorporation to labor in this province.

Public Administration and Security sector includes 10,981 people from which 8,058 are men and 2,923 are women. It is evident that men are still leading in this sector; however women stand out in teaching activities that gather 7.2% of active people in this sector where 7,890 are women and y 4,401 are men. Likewise, in human healthcare sector, 3,318 are women and 1,409 are men, another sector where female active population exceeds male active population. Then, Public Administration and Security is clearly masculine while Teaching and Healthcare is significantly feminine.

In 2010, Construction sector reached a record figure of 15,781 people. The most masculine sector in the province is characterized by youngsters.

Manufacturing Industry sector, including 15,061 active people in the province, shows an evident standstill and even a light setback regarding significance for active population compared to the other economic sectors.

Three subsectors concentrate approximately two thirds of active population in this sector: (i) food and drinks production industry (ii) textiles, leather and dressmaking industry, and (iii) furniture and timber industry.

Food Production Industry is an activity source for 1 of every 5 workers in the industrial

[5] Development and Land Use Plan, Machala Canton – 2018

sector and comprises 1.5% of PEA in this province. This indicates a low capability of agri-food sector in total to generate added value and take advantage of its great economic potential. For each active person in the agricultural sector, 0.06 - 0.08 active people in agri-food industry are present. This industry is also characterized for a low presence of active female population: 1 for every 4 women.

Textiles, leather and dressmaking industry is characterized by high female active population; 2 to 3 women.

Furniture manufacturing only represents 16% of active population in the industrial sector with a higher level of masculinization than agri-food sector[6].

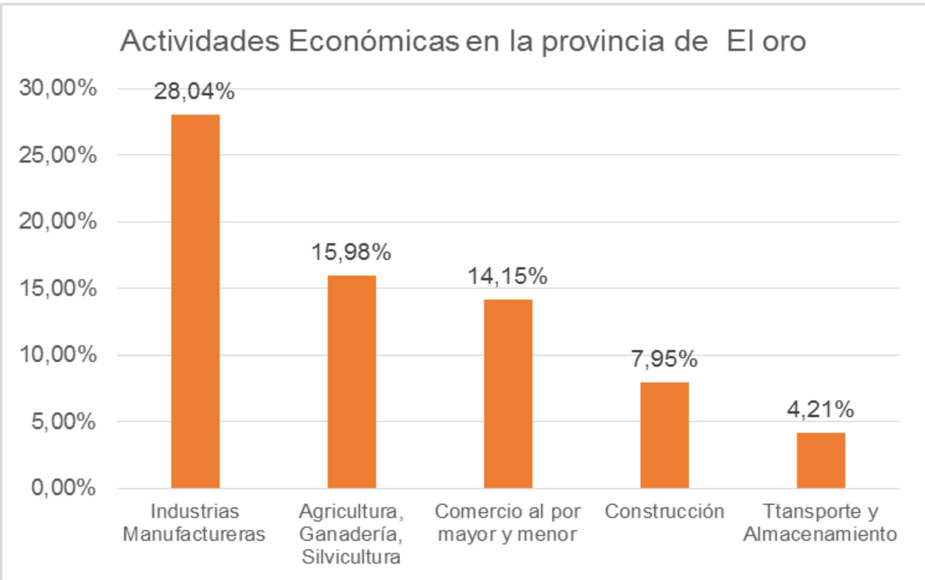
Table 8. *Economic Activities in El Oro Province*

Gender	Manufacturing Industry	Agriculture, Livestock, Forestry	Wholesale & Retail Trading	Construction	Transportation & Storage	Total
Men	2,495	2,312	1,314	1,480	765	10,980
%	22.72	21.06	11.97	13.48	6.97	
Women	2,826	720	1,371	29	34	7,994
%	35.35	9.01	17.15	0.36	0.43	
Total	5,321	3,032	2,685	1,509	799	18,974
Total %	28.04	15.98	14.15	7.95	4.21	

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

Figure 7. *Economic Activities in El Oro Province*



Manufacturing industries, Agriculture, Livestock, Forestry, Wholesale and retail trade, Construction, Transportation and Storage

Elaborated by: Ecosambito, 2020.

[6] Development and Land Use Plan, Machala Canton – 2018

6.2. Economic Activity in Machala Canton

Population in Machala Canton work in 21 activities considered the most important in the area. Among these, three are the most important with greater participation percentage[7]:

- Wholesale and Retail trading, including 27,192 inhabitants in Machala Canton that represent 25%.
- Secondly, Agriculture, Livestock, Forestry and Fishing including 14,244 inhabitants and representing 13%.
- Manufacturing Industry including 7,670 inhabitants and representing 7%.
- Construction sector also represents 7% including 7,593 inhabitants.
- Undeclared workers represent 7% and Transportation and Storage workers represent 6%.
- Education sector represents 5% and includes 5,312 economically active inhabitants.
- It is important to mention Public Administration representing 5% corresponding to 5,215 inhabitants, and Hosting and Food Service including 5,089 also representing 5%.
- Public Administration and Security, also considered an activity, represents 5% of Machala Canton population, including 5,215 inhabitants.
- New workers include 4,868 inhabitants that represent 4%.
- Remaining percentage between 0% and 3% represent other activities.

Table 9. *Activities in Machala Canton*

Activity	Population
Agriculture, Livestock, Forestry & Fishing	14,244
Mining and Quarrying	639
Manufacturing Industries	7,670
Electricity, gas, steam & air conditioning provision	473
Water supply, Sewage and Waste Management	487
Construction	7,593
Wholesale and Retail Trading	27,192
Transportation & Storage	6,579
Hosting and Food Service Activities	5,089
Information & Communication	1,301
Financing and Insurance Activities	362
Real Estate Activities	129
Professional, Scientific & Technical Activities	1,615
Administrative and Support Service Activities	2,384

[7] Development and Land Use Plan, Machala Canton – 2018

Activity	Population
Public Administration & Security	5,215
Education	5,312
Human Healthcare Activities	2.768
Arts, Entertainment & Recreational Activities	640
Other Service Activities	2,962
Domestic Employee Activities	3,557
Extraterritorial Organizations and Entities	5
Non-Declared	7,150
New Workers	4,868
TOTAL	**108,234**

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

6.3. Economic Activity in Puerto Bolívar

Puerto Bolívar is the main urban district in Machala Canton, where one of the most important export ports in the country is located. Approximately 85% of banana total production obtained in Ecuador is traded through Puerto Bolivar marine port.

However, other activities such as production and export of cacao, coffee, shrimp, tropical fruits, timber, seafood and minerals are present. Artisan fishing is also developed in Jambeli Archipelago estuaries and canals, where community has a limited area for fishing. Among communities, types of fish varies but the most common are: European bass, corvina, snapper, liza, grunt, anchovy, catfish, shorefish, moonfish, pompano, *cachema*, threadfish, leatherjacket fish, Raphael catfish, ray, sawfish, guitarfish, puffer, sole, and sea shrimp during May and April.

7. Education

Ministry of Education is in charge of observing, regulating, controlling and managing educational service, while on a cantonal level, it supervises infrastructure adaptation.

7.1. Illiteracy

In El Oro Province, illiteracy is 4.12% representing the lowest rate when compared with other provinces.

In Machala Canton, illiteracy is 3.10%, which represents 96.90% is literate[8].

7.2. School Dropout Rate

In El Oro Province, school dropout rate is 7.25%. According to 2010 Population and

[8] National Statistics and Census Institute (INEC), 2010 Population and Housing Census

Housing Census results, 9% of population older than 15 years of age who regularly attends educational centers have not finished basic education (school dropout), while in Machala Canton school dropout rate is 5%.

Table 10. *School Dropout Rate on a cantonal Basis*

Canton	Number of Students dropping out School System	Register Total	Dropout Rate
Arenillas	40	1,188	3.4
Atahualpa	40	548	7.3
Balsas	19	349	5.4
Chilla			
El Guabo	304	4,759	6.4
Huaquillas			
Las Lajas	3	354	0.8
Machala	40	796	5.0
Marcabeli	2	46	4.3
Pasaje	101	3,568	2.8
Piñas	35	1,537	2.3
Portovelo	6	449	1.3
Santa Rosa	132	3,174	4.2
Portovelo	118	2,780	4.3

Source: INEC, 2010 Population & Housing Census

Elaborated by: Ecosambito, 2020.

7.3. Educational Levels

According to 2010 Census undertaken by INEC, a total of 79,994 regular educational facilities are available in Machala Canton.

From that total, 57,956 are managed by the State and 20,821 are private institutions, representing 72% and 26%, respectively. A total of 802 educational centers are public-religious (*fiscomisionales)* and 415 are municipal schools.

According to this data, it can be concluded that Public Education system covers 74% (considering state, public/religious and municipal schools).

According to INEC 2010 Census, in Machala Canton, 68,681 inhabitants state their highest educational level is primary school. A total of 58,079 declared having secondary school and 36,790 inhabitants achieved university education.

Results show that only 2,218 inhabitants have post-degree education.

A total of 2,630 inhabitants are in preschool level and 17,958 access primary school, while 21,738 go to secondary school and 3,125 achieve post-graduate education.

8. Health

Ministry of Public Health in Ecuador is the competent body within the health system. Operational Units (UO in Spanish) are related to the National Health System and qualified according to their assistance type and level, determined by patient medical history and the demands for medical assistance.[9] SNS places Imbabura Province in Zone 7, along with Loja and Zamora Chinchipe Provinces.[10]

SNS is intended to improve systematically and progressively life and health levels of Ecuador inhabitants, and improve their life conditions. This system focuses on implementing health rights to every individual guaranteed by the Constitution of the Republic. SNS includes private, public, autonomous and communal health institutions and intends to fulfill the following objectives:[11]

1. Assure equal and universal access to integrated health assistance through a service network including decentralized management.
2. Integrally protect people from risks and damage to their health and environment from its deterioration or impact.
3. Generate healthy life environment, style and conditions.
4. Promote institutional coordination, complementation and development in health sector.
5. Incorporate citizen participation in planning and surveillance at every action level and condition regarding SNS.

Health service coverage in El Oro Province is highly significant in cantons with high concentration of population such as Machala, Pasaje and Santa Rosa.

Machala Canton has 68 health centers, both public and private. A total of 99% is distributed within urban area, which practically covers the whole population.

Machala Health District has achieved to organize Intercultural Health, Alternative Medical System for Allopathic Medicine Health Service, Health Zone Cadastral Registry N1 and 2 for year 2013 according to Integral Health Location Analysis, Health District 07d02, Machala-El Oro, 2014- 2015 Document that registers every healthcare center.

[9] Ministry Agreement No. 00005212, Alternative Typology to ratify Healthcare Facilities according to assistance levels and supporting services for National Health System. – Supplement – Official Registry No. 428, Quito – Friday, January 30, 2015.
[10] Ministry Agreement No. 00004521, Guidelines to organize healthcare facilities of Ministry of Public Health in Areas and Districts, November 14, 2013.
[11] Law No. 2002-80. Organic Law for National Health System, Official Registry No. 670, Quito: September 25, 2002.

Table 11. *Types of Health Centers on a Cantonal Level*

Center Type	Public	Private
Municipal Healthcare Center	9	0
Municipal Mobile Clinics	5	0
Private Healthcare Centers	0	22
Clinics	0	27
National Police Healthcare Center	1	0
Army Force Healthcare Center	2	0
Municipal Hemodialysis Center	1	0
Private Hemodialysis Center	0	1
Esperanza Hospital (Machala Curia)	0	1
SOLCA Hospital - Machala	1	0
Machala Social Security Hospital	1	0
Dr. Pomerio Cabrera Municipal Hospital	1	
General Hospital	1	0
Total	**22**	**51**

Source, Machala Health District, 2013

Elaborated by: Ecosambito, 2020.

The Ministry of Public Health has three facilities in the parish of Puerto Bolivar:

1. Puerto Bolivar Health Center 2.
2. Amazonas Health Center
3. Puerto Bolivar Epidemiological Surveillance Post.

Regarding physicians/inhabitants, the main canton area registers 884 physicians, an average of 33.5 professionals for every 10 thousand inhabitants.

This Canton registers 245,972 inhabitants, but the number of beds for health assistance is only 693; this is 25.9 beds for every 10 thousand inhabitants. Reportedly, Machala Canton has a deficit of 4.1 beds for every 10 thousand inhabitants to provide the whole population. This deficit is determined by Ministry of Public Health standards that relate 3 beds per every 1,000 inhabitants for an appropriate provision to population.

8.1. Mortality

Mortality rate is one of the main variables in demographic dynamics of a population. In this regards, evaluation is required since it is inversely related to life quality of inhabitants. During the last 20 years, Diabetes and Hypertension are the main causes of mortality on a provincial and cantonal level.

The main health problem in 2020 is COVID-19 pandemic that has impacted the whole world. Therefore, in Ecuador it became a “State of Health Emergency” on March 12, 2020 according to Agreement No. 00126-2020, thus impacting Ecuadorians severely since health system was already collapsed and no vaccine is available to date.

Coronavirus 2019 (COVID-19) is a respiratory disease caused by SARS-CoV2 virus. It has spread to a great number of countries around the world, thus impacting each one on mortality and morbidity levels and responsiveness of healthcare services. Furthermore, everyday life aspects like economic and social activities, including traveling, trading, tourism, food supply and financial markets, among others could be impacted.

Based on the foregoing, Presidency and Vice-presidency of the Republic, Ministry of Health (MSP), Ministry of Labor (MT) and Ministry of Government (MG) have issued general guidelines to direct population on measures required to mitigate virus transmission, which must be adopted in different activities and sector in order to reinforce a response during virus mitigation phase.

To November 16, 2020, 7073 cases of COVID-19 have been confirmed and 518 casualties were reported in El Oro Province, while 3507 transmission cases have been confirmed in Machala Canton[12].

8.2. Morbidity

In the GeoSalud portal, information is available for two of the three health facilities (Centro de Saludo Puerto Bolivar and Amazonas) registered. The available official data given by the Ministry of Public Health (MSP) is from 2016.

Table 12. Morbidity in the parish of Puerto Bolivar1

MAIN CAUSES	TOTALS			PERCENTAGE		
	MAN	WOMAN	TOTAL	MAN	WOMAN	TOTAL
Urinary tract infection unspecified site		827	920	1,96%	7,91%	6,05%
Acute rhinopharyngitis [common cold].	351	432	783	7,38%	4,13%	5,15%
Intestinal parasitosis not otherwise specified	335	440	775	7,05%	4,21%	5,09%
Unspecified acute pharyngitis	254	355	609	5,34%	3,39%	4,00%
Inflammatory cervical disease	0	568	568	0	5,43%	3,73%
Diarrhea and gastroenteritis of presumed infectious origin	259	281		5,45%	2,69%	3,55%
Streptococcal tonsillitis	243	217	460	5,11%	2,07%	3,02%
Unspecified acute tonsillitis		237	434	4,14%	2,27%	2,85%
Candidiasis of the vulva and vagina	0	324	324	0	3,10%	2,13%
Acute cystitis		252	285	0,69%	2,41%	1,87%
Essential (primary) hypertension				2,00%	1,53%	1,68%
Unspecified acute bronchitis	86		186	1,81%	0,96%	1,22%
Unspecified atopic dermatitis		101		1,41%	0,97%	1,10%
Iron deficiency anemia not otherwise specified				1,35%	0,92%	1,05%
Unspecified obesity	45	110		0,95%	1,05%	1,02%
Genital infection in pregnancy	0				1,37%	0,94%
Mild protein-calorie malnutrition				1,28%	0,77%	0,93%
Unspecified amebiasis				1,05%	0,80%	0,88%
Dyspepsia				0,82%	0,85%	0,84%
Headache		91		0,63%	0,87%	0,80%
Obesity due to excess of calories				0,93%	0,68%	0,76%
Acute vaginitis	0			0	1,03%	0,71%
Strep throat				0,82%	0,54%	0,62%
Mixed hyperlipidemia				0,61%	0,57%	0,58%
Superficial mycosis without other specification				0,44%	0,63%	0,57%
Impetigo [any anatomical site] [any organism].				1,01%	0,34%	0,55%
Unspecified fever				0,74%	0,47%	0,55%
Unspecified gastritis				0,44%	0,53%	0,50%
Unspecified allergic rhinitis				0,78%	0,34%	0,48%
Unspecified low back pain				0,46%	0,49%	0,48%

[12] Ministry of Health, Ecuador, 2020.

MAIN CAUSES	TOTALS			PERCENTAGE		
	MAN	WOMAN	TOTAL	MAN	WOMAN	TOTAL
Unspecified back pain	28	42		0,59%	0,40%	0,46%
Localized upper abdominal pain				0,42%	0,38%	0,39%
Joint pain			58	0,25%	0,44%	0,38%
Non-insulin-dependent diabetes mellitus without mention of complication				0,29%	0,38%	0,35%
Constipation				0,50%	0,29%	0,35%
Unspecified allergy			45	0,32%	0,29%	0,30%
Pterygium				0,36%	0,26%	0,29%
Unspecified urinary tract infection in pregnancy	0			0	0,35%	0,24%
Secondary amenorrhea	0			0	0,30%	0,20%
Unspecified neuralgia and neuritis	5			0,11%	0,23%	0,19%
Allergic contact dermatitis of unspecified cause				0,25%	0,14%	0,18%
Lumbago with sciatica				0,13%	0,12%	0,12%
Pelvic and perineal pain	0			0	0,17%	0,12%
Pure hypercholesterolemia				0,04%	0,11%	0,09%
Other acute gastritis				0,06%	0,07%	0,07%
Tension headache		5		0,04%	0,05%	0,05%
Other iron deficiency anemias	1			0,02%	0,02%	0,02%
Myalgia	0			0	0,03%	0,02%
Acute upper respiratory tract infection, unspecified	1	1		0,02%	0,01%	0,01%
Grand total	4.753	10.461	15.214	100%	100%	100%

Source: Ministry of Health, 2016

As can be seen, the main medical care in the parish is related to urinary tract infection, acute rhinopharyngitis [common cold], intestinal parasitosis without further specification, unspecified acute pharyngitis, inflammatory disease of the uterine cervix, diarrhea and gastroenteritis of presumed infectious origin, streptococcal tonsillitis, among others.

9. Housing

In 2010, 159,016 homes were available in El Oro Province. Currently, there are 75,479 on a cantonal basis; this means (in absolute figure) 3.4 people live per home, as a median average. Additionally, 72.69% homes are house/villa type, so it can be deduced that approximately 186,000 people live in this kind of home, which demonstrate a housing culture among inhabitants[13].

Percentages about the type of home also demonstrate that practically the whole canton has a horizontal growth for their human settlements since only 9.99% live in apartments.

10. Utility Services

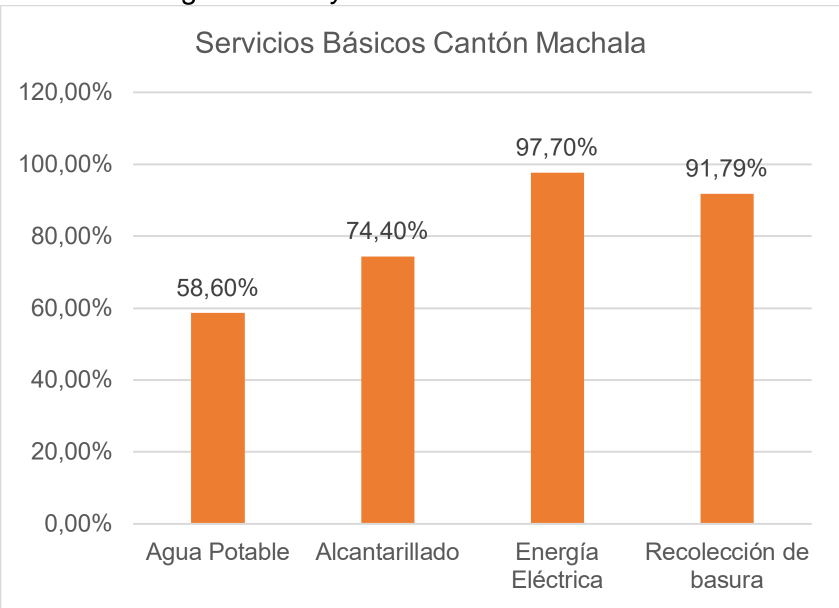
Utility services are infrastructure works that improve life quality of a population resulting in reduction of diseases and therefore saving resources. Besides, they enable access to information and communication. Utility services considered are: electricity, water for consumption, waste management and sewage system.

In El Oro Province, from 159,016 homes registered, 97% include electricity, 56% drinking

[13] Development and Land Use Plan, Machala Canton – 2018.

water, 86% waste management and 64% sewage system.

Figure 8. *Utility Services in Machala Canton*



Elaborated by: Ecosambito, 2020.

Previous figure shows that electricity is the most covered service in the whole canton, followed by waste management, sewage system and the least covered service is drinking water.

In Machala Canton, 28.73% of the population has local telephone in their homes; therefore 71.27% do not count on this service.

According to INEC data, 84.20% of homes in Machala Canton have mobile telephone service and 15.80% lack of this service.

In Machala Canton, 16.73% of homes have internet service.

Since the state of emergency and a year later the Humanitarian Support Law have been established increasing costs, fees or tariffs to utility service and telecommunications is prohibited. This means that fees may not be increased until September 15, 2021. Every company providing utility and telecommunication services should not apply any outage for default of payment as long as the state of emergency is valid and after two months it is terminated. This means prohibition for service outage is valid until November 15, 2021. Companies may start charging accumulated payment dividing them into twelve equal installments without any interests, fines or surcharges.[14]

Regarding utility services, during the State of Emergency due to COVID-19, population must not be left without any service. Therefore, it was resolved that electricity over 500 kilowatts for companies and homes will be charged at 10 cents per kilowatt/hour.

[14] This content has been originally published by **EL COMERCIO Journal in the followinglink:**https://www.elcomercio.com/actualidad/prohibicion-corte-servicios-basicos-pago.html.

11. Road Management

In El Oro Province, the State Road Network covers 400.94 kilometers, while Provincial Road Network extends 2,652.58 kilometers, from which 1,145.01 kilometers belong to Strategic Axes and 1,507.57 kilometers are Country Roads, not including bridleways.

State Road Network comprises a set of primary and secondary roads including the greatest vehicle traffic, interconnect province capitals, main towns in cantons, international border ports with our without customs office, and big and medium economic activity centers managed by the Ministry of Transport and Public Works.

11.1. Provincial and Cantonal Road Network

El Oro Provincial Road Network is a set of roads managed by provincial government according to 2014-2025 Road Management Plan. This network comprises tertiary roads divided in accordance with significance into four strategic axes and country roads.

Tertiary roads connect main districts and production areas to National Road Network roads and country roads with low traffic.

A total of 18% (488.90 km) belongs to the main provincial strategic axis, 14% (375.32 km) to secondary provincial roads, 8% (209.74 km) to main cantonal roads, 3% (71.05 km) to secondary cantonal roads, and 57% (1,507.57 km) to country roads.

Table 13. *Vial Road Network Conditions*

Provincial Road Network	Very Good	Good	Regular	Poor	Very Poor	Total in Km
Main Provincial Strategic Axis	57.40	166.59	125.36	69.95	69,90	488.90
Secondary Provincial Strategic Axis	66.80	91.16	119.46	79.20	18,70	375.32
Main Cantonal Strategic Axis	21.35	44.09	12.18	121.98	10,14	209.74
Secondary Cantonal Strategic Axis	3.76	10.92	22.90	26.87	6,60	71.05
Country Roads	5.04	101.40	189.62	1,033.35	178,16	1,507.57
Provincial Road Network	**154.35**	**414.16**	**469.52**	**1,033.35**	**283.20**	**2,652.58**
Percentage %	**6%**	**16%**	**18%**	**50%**	**11%**	**100%**

Source: El Oro Province Development Plan - 2015.

Elaborated by: Ecosambito, 2020.

Regarding Type of Wearing Courses, from a total of 2,652.58 (excluding bridleways); 19% are paved roads; only 0,1% are cobbled roads, 43% are ballast roads and 38% are dirt roads (natural soil); therefore, 81% are ballast and dirt roads.

Table 14. *Characteristics of Road Networks*

Provincial Road Network	Paved		Cobbled	Ballast	Dirt (natural soil)	Total Km
	DTSB	Asphalt Layer				
Main Provincial Strategic Axis	161.25	18.0		240.11	69.54	488.90
Secondary Provincial Strategic Axis	69.56	97.75		162.01	46.00	375.32
Main Cantonal Strategic Axis	13.12	33.85	1.46	107.69	53.62	209.74
Secondary Cantonal Strategic Axis	14.20	14.68		42.17		71.05
Country Roads	40.19	45.62		593.20	829.56	1,507.57
Provincial Road Network	**298.32**	**209.90**	**1.46**	**1,145.18**	**997.72**	**2,652.58**
Percentage %	**19%**		**0.1%**	**43%**	**38%**	**100%**

Source: El Oro Province Development Plan - 2015.

Elaborated by: Ecosambito, 2020.

11.2. Transportation Network

Main transportation system is by land. A total of 18 cooperatives with 644 vehicles including buses and vans for interprovincial and inter-cantonal transport are present. Heavy transport is performed by 7 cooperatives including 110 trucks and light-load transport is performed 12 cooperatives including 236 pick-up trucks and light trucks. Besides 23 taxi cooperatives including 608 vehicles are present.[15]

Maritime transport is mainly performed from Puerto Bolivar, located in the northwestern part of the province, under jurisdiction of Puerto Bolivar urban district in Machala Canton. This part is also located south of Guayaquil Gulf, at the entrance of Santa Rosa Canal, protected by Jambeli Archipelago. On a national basis, Puerto Bolivar is the second most important port in the country due to load volume that it is transported this way. Eighty percent of national banana production is exported by this port. This is a terminal apt to hold any type of vessel and load: ships for banana cargo, refrigerated paddles and containers, dry containers, vehicles, machines, coils and others.

12. Migration

In 2002, a total of 2,880 people migrated from El Oro Province, while in 2010, only 570 people left this province. This means a greater development in provincial production was present.

[15] Development and Land Use Plan, Machala Canton – 2018.

Total canton population registered in 2010, showed that 6,541 people migrated; 51% men and 49% women. From this total, 5,734 range between 15 and 64 years of age. Main causes for migration are in order of priority: work, family reunion and education.

Table 15. *Main Reasons for Migration*

Migrant Gender	Work	Education	Family Reunion	Others	Total
Men	2,352	287	542	155	3,336
Women	2,130	270	664	141	3,205
Total	**4,482**	**557**	**1,206**	**296**	**6,541**

Source: Development and Land Use Plan – Machala Canton, 2018.

Elaborated by: Ecosambito, 2020.

Main receptor countries for all 6,541 migrants, 2,6% of total canton population, are: United States of America, 9.3%, Chile 2.05% and Argentina 0.96% of migrating population.

According to a study prepared by both Ministry of Defense and IEE (Institute of Ecuadorian Studies) in 2013, 2,659 people arrived to the canton from other countries; 65.06% from Latin America, 26.14% from Europe, 8,5% from Asia and 0.3% from Africa, according to 2010 Census. In global percentage, they only represent 1.08% from total of inhabitants.[16]

13. Touristic and Cultural Activities

A Table by Ministry of Tourism illustrates tourist arrivals in El Oro Province per month. This is a reference about Machala Canton since an estimated 40% of tourists visit Machala Province capital. According to Ministry of Tourism data, in 2011 approximately 14, 772 visitors, mostly for paperwork activities performed in the provincial capital were registered.

Regarding foreign tourists moving in Machala Canton, 60% corresponding to 22,159 visitors, come from other cantons in El Oro mainly for gastronomical reasons and visit to cultural sites. January and February are the months of greatest tourist flow.

Labor in touristic activities involves 3,664 people, from which 60% to 40% are women, being an important unpaid segment in this activity. This situation is more evident in accommodation and food service activities than in arts, entertainment or recreation. This is presumed to happen because food service activities are mostly family undertakings where a female owner is head of household and does not work under employment regime.

The most attractive touristic sightseeing within the project area[17] are:

<u>Puerto Bolívar</u>

Named to honor Liberator Simon Bolivar, this port connects El Oro Province with other ports in the world, since it holds 85% of national banana production. In Puerto Bolivar,

[16] Technical Summary, Machala Canton, Geo-information Generation for land management at national level, Scale 1: 25000, Socio-economic Project, December 2013, Ministry of National Security, IEE *et al*.

[17] Development and Land Use Plan, Machala Canton – 2018.

marine breeze, landscape, beautiful sunsets and delicious dishes made with seafood, especially the best *ceviche* in the world can be enjoyed. On the other hand, Puerto Bolivar is the starting point to visit Jambeli Island, *Isla del Amor* (Love Island) and Santa Clara or *Isla del Muerto* (Island of the Dead)

Old Cabotage Wharf in Puerto Bolivar

It was built by Gaston Thoret, construction engineer, and opened on May 9, 1902. From this site cabotage ships transporting passengers and cargo from and to Guayaquil and Santa Rosa (currently Pital Port) departed. Many vessels such as Jambelí, Bolívar, Colón, Dayse Edith, Quito, etc. offered such service until 1973, when Oro-Guayas road was finished. Currently, after being remodeled, it has become an interesting place including a marine museum owned by the Cultural Center and an elegant restaurant named *El Viejo Muelle*.

Jambelí Island

Machala is the starting point towards this friendly island located 35 minutes away from Puerto Bolivar by ferryboat. It is worth mentioning the island does not belong to this canton; however, boats to go to the archipelago are taken from Puerto Bolivar in Machala. The ride becomes an exciting adventure by looking at an attractive scenery, variety of birds and a mangrove in the area. Jambeli is the largest open sea beach in the archipelago and also the most populated one. There are many restaurants, accommodation, recreation and sport places including Geo Mer Marine Museum.

Towards the eastern part of the island and bordering Santa Rosa estuary, shrimp industry, which restrains touristic and residential expansion possibilities, is located.

Currently, the mangrove area has been reduced due to its indiscriminate development by shrimp production.

Among touristic activities undertaken by the district, especially in Isla Costa Rica community, a facility to provide accommodation to visitors has been implemented during the last few years.

In Costa Rica, Bellavista and Las Huacas, facilities to provide with drinks and food to locals and foreigners, with great success especially on holidays or special events have also been implemented.

Isla del Amor (Love Island)

Located five minutes away from Puerto Bolivar by ferryboat, this island is a great experience for nature lovers and ornithologists, since this where a great variety of birds develop, and that is why it has that name; it's a place where birds nest and reproduce.

Santa Clara Island

Located 90 minutes away from Puerto Bolivar, this island is a temple for ancient indigenous cultures where remains of an Inca sanctuary. Also known as the Island of the Dead because from the distance it looks like a man lying dead, Santa Clara is similar to Galapagos Islands in its volcanic structure and fauna, since it is habited by birds, sea lions, iguanas, blue-footed boobies, frigatebirds, etc. From July to September, whale watch, one of the most expected attractions to foreign tourists takes place.

Machala City

Although new on a canton basis, touristic activity has increased since the last six years, as demonstrated by increasing touristic facilities within the city and the province in general.

Machala has 183 touristic facilities (qualified by Ministry of Tourism and provided with a Touristic Operation License) and accommodation infrastructure including 60 lodging facilities with an average of 3,180 rooms.

14. Political-administrative Aspects

The Ecuadorian government is organized in territories, regions, provinces, cantons and districts, each territory has a decentralized autonomous government (*GAD-Gobierno Autónomo Descentralizado)* for development management by exercising powers. This government will be composed of democratically elected citizens who will exercise their political representation. Decentralized autonomous governments include: a) regional governments, b) provincial governments, c) cantonal or metropolitan district governments, and d) rural districts.

In provinces, cantons and rural districts, Indigenous, Afro-Ecuadorian and Montubio territorial constituencies may be formed.

Decentralized autonomous governments (GAD in Spanish) main roles are framed on: a) legislation, standards and supervision, b) execution and administration, c) public participation and social control.

In El Oro Province, a Decentralized Autonomous Government (GAD) or Prefecture is a law person of public right, with political, administrative, financial and publicly elected autonomy and its highest authority is the Prefect.

Machala Canton is represented by the Municipal Decentralized Autonomous Government of Machala or Municipality, a law person with public rights, political, administrative, financial and publicly elected autonomy, and its highest authority is the Mayor and both urban and rural Councillors.

Regarding districts (*parroquias)* as a result of 1998 Constitution reforms and their ratifications by 2008 Constitution, Decentralized Autonomous District (*Parroquial*) Governments (GADP) also called Rural District Board (*Junta Parroquial Rural*) is the government body in the rural district and is composed of chairpeople elected by popular vote, and whoever is most voted will be its president.

In El Oro Province, the state representative on a provincial basis is the Governorate. On a cantonal basis, the representative of Ministry of Government is the Political Chief of Machala Canton.

On a local basis, presidents of communities, quarters and sectors are valid authorities.

15. Enquiry Systematization

15.1. Systematization

15.1.1. Enquiry Coverage

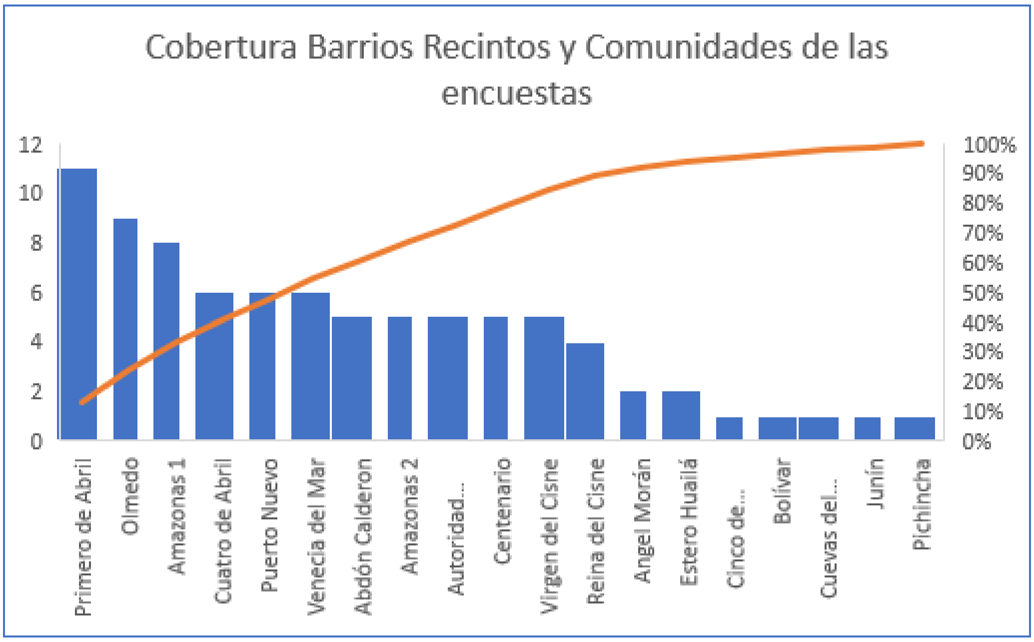
This enquiry was performed taking into account Quarters, Premises and Communities located in Puerto Bolivar Urban District, Machala Canton in order to cover influence area of the project:

Table 16. *Areas covered by Enquiries*

Quarters/Premises/Communities	No. of Enquirers
Cinco de diciembre	1
Abdón Calderón	5
Amazonas 1	8
Amazonas 2	5
Port Authority	5
Bolívar	1
Centenario	5
Angel Morán	2
Cuatro de Abril	6
Cuevas del Huayco	1
Estero Huailá	2
Junín	1
Olmedo	9
Pichincha	1
Primero de Abril	11
Puerto Nuevo	6
Reina del Cisne	4
Venecia del Mar	6
Virgen del Cisne	5
TOTAL	**84**

Original Source: Ecosambito, 2020.

Figure 9. *Areas covered by Enquiries*

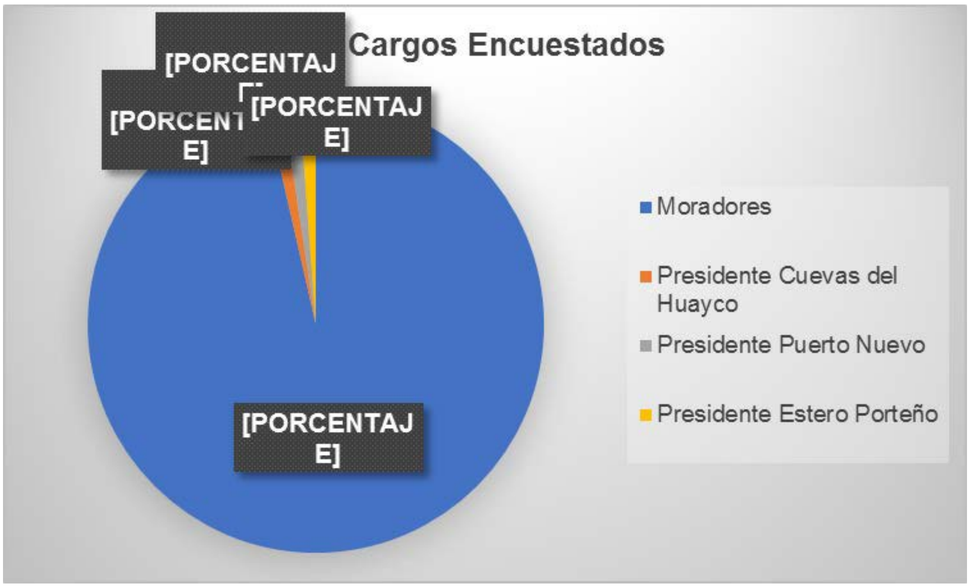


Elaborated by: Ecosambito 2020

15.1.2. Characteristics of Enquiry Respondents

This enquiry was applied 97% to common inhabitants and 3% among Quarters, Premises and Community presidents.

Figure 10. *Type of Enquiry Respondents*

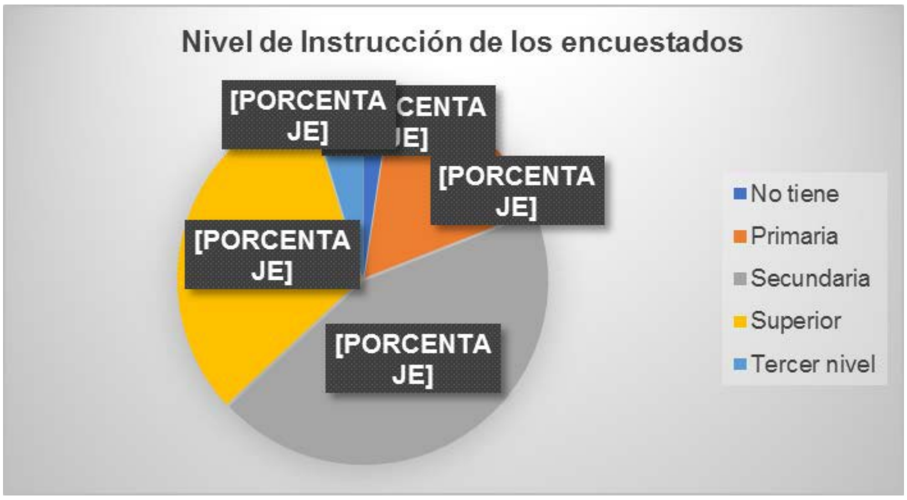


Porcentaje;Percentage, Cargos encuestados: Surveyed positions, Presidente:President

Elaborated by: Ecosambito 2020

A total of 44% respondents have secondary education, 32% have higher education (university), 17% have primary education, 5% have a tertiary educational level, and 2% lack of educational level.

Figure 11. *Educational Level of Enquiry Respondents*

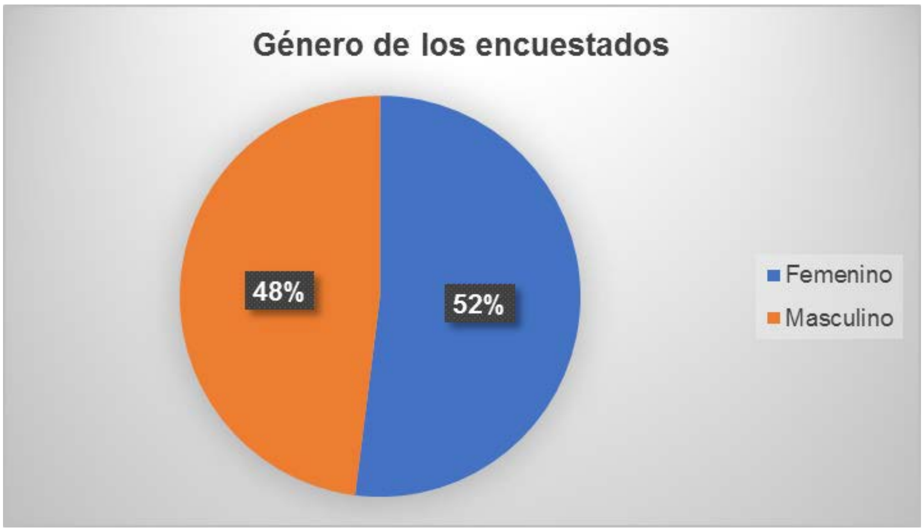


Nivel de Instrucción de los Encuestados: Education level of survey respondent, Porcentaje: Percentage, No tiene: Does not have; Primaria: Primary, Secundaria: Secondary: Superior: Superior; Tercer nivel: Third level.

Elaborated by: Ecosambito 2020

Regarding gender percentage of respondents, 52% are women and 48% are men. The highest percentage for female gender is mainly originated because in this area, women stay at home to take care of their children and perform house chores.

Figure 12. *Gender of Respondents*



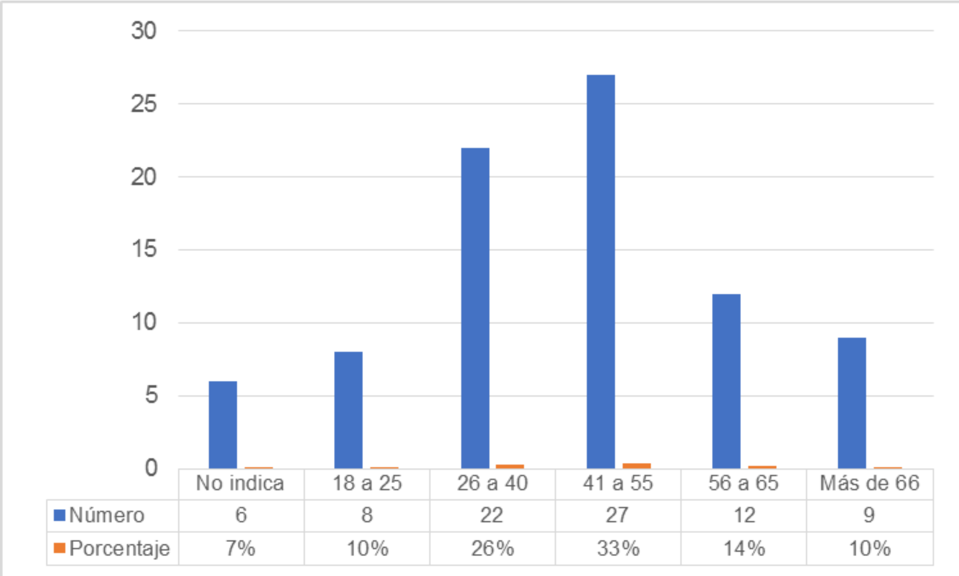
Nivel de Instrucción de los Encuestados: Gender of survey repondents; Femenino: Female; Masculino: Male

Elaborated by: Ecosambito 2020

This enquiry considered the last electoral register (currently being used for 2021

Ecuadorian Presidency including men and women older than 18) as in the case ofenquiries, the majority (33% of respondents) ranges between 41 to 55 years of age, 22% range between 26 and 40 years of age, and the third group ranges between 56 and 65 years of age.

Figure 13. *Age Rate of Respondents*

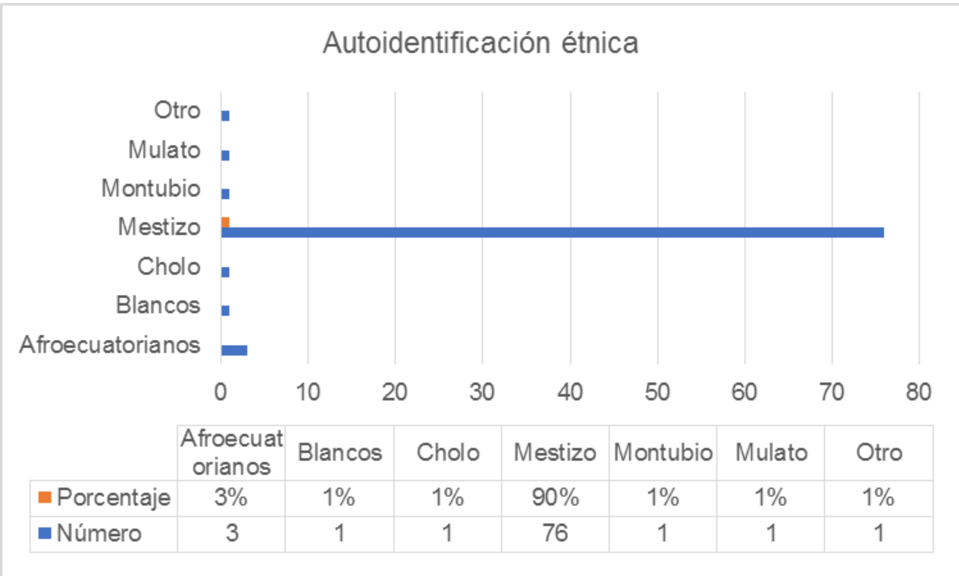


Not indicated, Number, Percentage, More than 66

Elaborated by: Ecosambito 2020

Self-identification of respondents show 90% are mestizo, while 3% are Afro-Ecuadorian and 7% is distributed among white, *cholo,* Montubio and mulatto.

Figure 14. *Ethnic Self-Identification of Respondents*

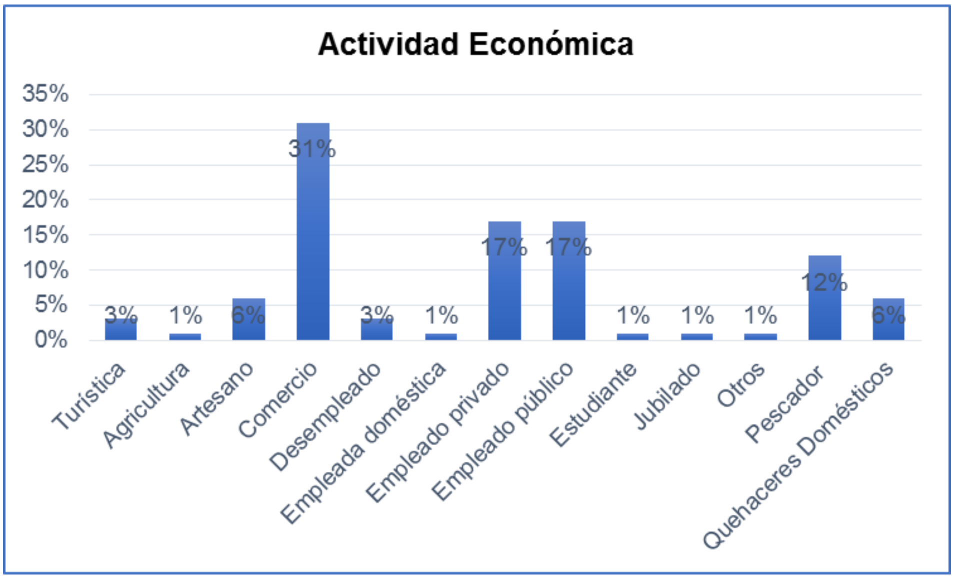


Elaborated by: Ecosambito 2020

15.1.3. Economic Activity of Respondents

Respondents have typical economic activities in the area, considering it is a district with a high production and trading rate. The main activity of respondents is trading (31%), while private workers and civil servants share the same percentage (17%) and fishermen range 12%. Respondents ranging 3% are currently unemployed mainly because many businesses have closed due to the pandemic.

Figure 15. *Economic Activity of Respondents*



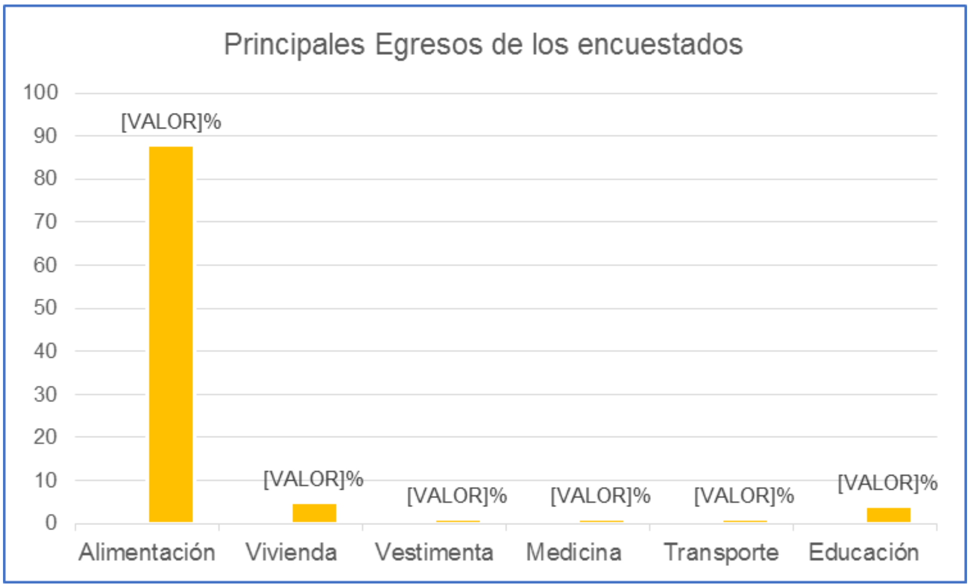
Economic activity; Tourism, Agriculture, Artisan, Commerce, Unemployed, Domestic employee, Private employee, Student, Retired, Other, Fisherman, Housework

Elaborated by: Ecosambito, 2020.

Among percentage of respondent families, the first place is for parents who work in trading business (31%); the second place is for public servants (18%); in the third place are private workers (17%) and in the fourth place are fishermen (16%). Remaining 18% corresponds to daily workers, farmers, artisans and other activities as house work. Families with children in working age mainly perform trading, handicraft and fishing activities.

Main expenses by families of respondents are food, housing, education, clothing, medicine and transportation with the following percentages:

Figure 16. *Expenses of Respondents*



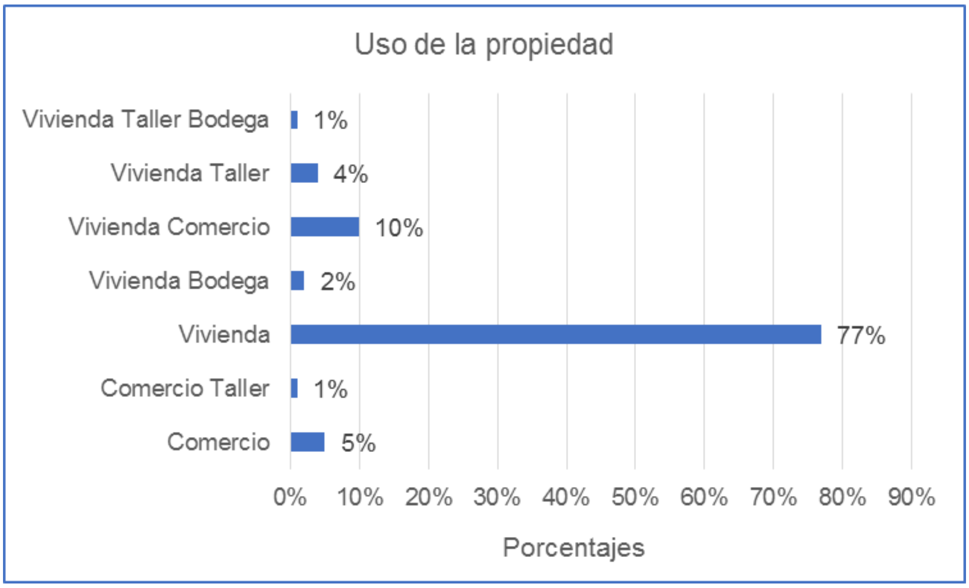
Main expenses of respondents, Food, Housing, Clothing, Medicine, Transport, Education

Elaborated by: Ecosambito, 2020

Regarding real estate properties owned by the respondents, 77% are homes, 10% are used both as home and business, 5% are stores or business, 4% are used as homes and workshops, 2% as homes and warehouses, and the rest (2%) are shared as home-workshop-warehouse all in a single room, and as business and workshop.

The use of real estate properties reveals a significant aspect of life conditions for people, since many families use the front part of their real estate as store or business and the back part as home in order to avoid double renting.

Figure 17. *Property Use of Survey Respondent*



Property Use, Home Workshop Warehouse, Home business, Home Warehouse, Home, Commerce workshop, Commerce

Elaborated by: Ecosambito, 2020.

15.1.4. – Utility Services

A total of 89% of Quarters, Premises and Communities where enquiries were performed have every utility service: electricity, drinking water, sewage system, telephone. Only 26% have internet service, which currently due to the pandemic has also become a utility service. The majority of respondents use communication media such as television, radio and printed press.

15.1.5. Educational Services

The following educational centers were found in the surveyed area:

Mauro Matamoros Mesa Primary School (enquired)

Its principal is Mrs. Maira Canga. This is a primary school including first to seventh grade, Spanish-speaking, and financed by the Central Government via Ministry of Education. It operates in the morning, in presence-based modality (currently due to the pandemic, classes are in the virtual/online mode), and has 171 students (School Year 2020-2021); none with special ability. Last year, 185 students were enrolled.

This school has an audiovisual room used as computing class including a few computers without internet connection. No uniform or school meal is provided to students. The government only provides with school texts. Administrative premises are shared with an infirmary. They have multipurpose fields and restrooms are in poor conditions. They have every utility service: electricity, water supply and telephone, except for internet service.

Access road to this center is Primera Este Street in regular condition. Students enrolled in this school come from *Cuatro de Abril, Wilson Franco,* and *Gonzáles Rubio* quarters. There is a Parent Committee in charge of supporting efforts to improve this institution.

Julio María Matovelle Private Educational Center (enquired)

Its principal is Sister Bertha Velasquez. This is an integrated school including first to twelfth grade, Spanish-speaking, and financed by private funds (parents pay on a monthly basis). It operates in the morning, in presence-based modality (currently due to the pandemic, classes are in the virtual/online mode), and has 400 students (School Year 2020-2021), 17 with special abilities. Last year 560 were enrolled. This shows a dropout situation is present due to the pandemic and parents' low income that makes it difficult to keep on paying a monthly fee for education.

This center has an audiovisual room and a library. No school meal, uniform or text is provided to students. It has a multipurpose field and restrooms. Every utility service, electricity, water, telephone and internet, is available. Access road to this center is Gonzalo Cordova Street. Students enrolled in this Educational Center come from surrounding quarters up to El Guabo. There is a Parent Committee in charge of supporting efforts to improve this institution.

Manuel Isaac Encalada Primary School (enquired)

Its principal is Mrs. Natividad Fernandez. This is a primary school including first to seventh grade, Spanish-speaking, and financed by the Central Government via Ministry of Education. It operates in the morning, in presence-based modality (currently due to the pandemic, classes are in the virtual/online mode), and has 484 students (School Year 2020-2021), 3 with special abilities. Last year 362 were enrolled. This increasing number of students results from parents changing their children from private to state schools to avoid paying monthly fees due to the pandemic because several have lost their jobs.

This school has a computing classroom with deficient internet service. No school meal, uniform or text is provided to students. Administrative premises are small. It has a yard, a basketball court and restrooms in regular condition. Every utility service, electricity, water, telephone and internet, is available. Although a robbery took place and internet services are being reestablished. Students enrolled in this school come from *Amazonas 1 & 2, Tiwntza*, and *La Unión* quarters. There is a Parent Committee in charge of supporting the institution by self-supporting activities and cleaning the school.

- Virgen de Fatima Secondary School
- 24 de Julio Primary School
- Virgen del Cisne Secondary School
- Simon Bolivar High School
- Juan Bautista Primary School

15.1.6. Healthcare Services

Regarding healthcare, Pomerio Cabrera Municipality Hospital, Puerto Bolivar Healthy Sub-centers, and Amazonas Health Center (enquired) are present in the area.

Amazonas Healthcare Sub-center

Located in Amazonas 1 Quarter, its representative is Dr. Maria Fernanda Banchon. It includes 3 general physicians, 1 obstetrician, 2 odontologists, 2 nurses, 1 administrative assistant, 2 statistics experts, and 2 auxiliary assistants. They have corresponding instrumental and equipment, and medical supplies. It is open from 8:00 a.m. to 5:00 p.m. Appointments are required by call center, but they assist directly in case of emergencies. Service is free and assistance average is 20 to 40 patients per day. Coverage extends from Loja Private Technical University to Port Authority. When a case cannot be assisted, it is sent to first or second-level healthcare facilities.

Main diseases treated in this healthcare center are: urinary infections, diabetes, common colds, tonsillitis, and hypertension.

Immunization and Ministry of Public Health programs are available in this center. Currently, they are working on a program to avoid gender violence.

They have every basic utility and special waste is sent to GADERE, an environmental management company.

15.1.7. Community and Recreation Services

Regarding community services, terrestrial transportation service, Puerto Bolivar Taxi Cooperative, Communal Police Units (in Amazonas 1, Cuatro de Abril, and Olmedo quarters), and Community Centers (*Casas Comunales*) are available in every quarter.

Main recreational and sport services are located in: Huaylá Estuary, El Cangrejo Theme

Park, Parque de la Madre (Mother's Park), Malecón de Puerto Bolívar (boardwalk), Isla del Amor (Love Island).

15.1.8. Communication Roads

Regarding communication roads, 63% have pavement in regular condition, 14% with pavement in good condition; 10% have pavement in bad condition, 6% are cobbled roads in good condition, 4% are cobbled roads in regular condition and 3% are cobbled roads in poor condition.

15.1.9. Main Requirements in Enquired Area

Main requirements in surveyed quarters, premises and communities are:

1. A total of 64% of enquiry respondents stated that policy security in quarters is the most important requirement since delinquency has increased.
2. Secondly, 30% stated public lighting is missing in some streets.
3. In third place, 6% stated that repairing streets is a significant requirement, -due to their poor conditions-, as well as implementing green areas.

15.2. Social Actors

Social actors identified in enquiries are local organizations:

- *Estero Porteño* Artisan Women Group
- *Puerto Nuevo* Older Adults Group
- *Productos del Mar* Autonomous Seafood Producers and Others Association
- *Venecia del Mar* Autonomous Seafood Producers and Others Association
- *24 de Junio* Coast Fishermen Association
- FUNDACORP
- *Puerto Bolívar* Artisan Women Association

15.3. Social Perception

15.3.1. Project Acknowledgement

Enquiries performed show that 82% of respondents know nothing about the "Extension of Dredging Operations, Facility Improvement and Dock 6 Construction in Puerto Bolivar" Project. Therefore, they request inclusive and participative socializations through Disclosure Meetings (48%); Information Stands (23%); Brochures and Information Leaflets (21%) and Radio (8%).

15.3.2. Usable Goods and Services

Regarding usable goods and services in the coastal area, the respondents answered the most important are artisan fishing (62%); species trading (24%); and tourism (14%).

15.3.3. Sensitive Habitats

Sensitive habitats in the area identified by enquiry respondents are the following:

- Huayla Estuary
- *Isla del Amor* (Love Island)

Regarding women participation at work in the area, the following were identified: beheading seafood (32%), seafood trading (32%), handicraft manufacturing (11%), fishing (11%) and shellfish collection for sale (8%).

15.3.4. Advantages and Disadvantages of Dredging Operations

Public perception and criteria regarding pros and cons of dredging operations in the area were the following:

Table 17. *Advantages and Disadvantages of Dredging Operations*

Advantages	Disadvantages
More employment	Harmful to Nature
Tourism growth	Adverse impact to fishermen
Canal improvement	Harmful to the ecosystem
Improved access to Jambelí	Adverse impact to species
Business Activation	High swells
Bad odor minimization	Scaring away marine species
Deep-sea Ships Entrance	Danger of Extinction for shrimps
Boat traffic improvement	Much traffic in the area
Greater productivity and trading	Damage to sea floor
Greater appreciation for Puerto Bolívar	Fauna imbalance
Economic growth in this District	Environmental Impact

Original Source: Ecosambito, 2020.

15.3.5. Women Participation in Fishing, Shellfish Collection and Shrimp Catching Activities

Most enquiries identified shrimp beheading as the main activity performed by women, followed by business, craftsmanship and other activities.

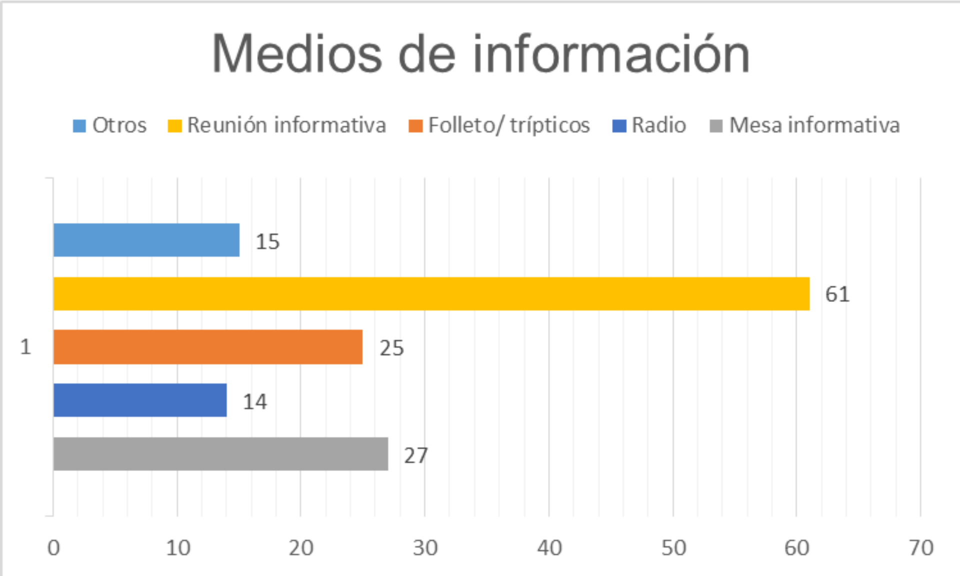
Figure 18. *Women Participation in Fishing, Shellfish Collection and Shrimp Catching Activities*

Elaborated by: Ecosambito, 2020.

15.3.6. Would you like to get more environmental and social Information about the Project?

Answers to this question were 98% affirmative. Many options to obtain this information were suggested. From these, disclosure meetings were the most favored, followed by information stands, and information leaflets.

Figure 19. *Favorite Means of Environmental and Social Information about the Project*



Information media, Other, Information meeting, Brochure/triptych, Radio, Information table

Elaborated by: Ecosambito, 2020.

16. Social actors and stakeholders

The identification of people, organizations, institutions, and any other group that may be or feel affected, or in turn, affect, directly or indirectly, the development of the project, is necessary in order to identify the expectations and roles that each of these parties has within the project. With this identification and analysis, we will be able to establish management strategies that consider the participation or involvement of these groups in an effective and active way.

The identification of social actors has been obtained from three sources:

1. Previous social participation processes of the project
2. Surveys, informative workshop, and interviews conducted as part of the primary data collection.
3. Secondary information.

The following is the list of identified social actors, in which 8 groups have been established:

- Governance and control institutions
- Production associations: shrimp and bananas
- Educational Institutions

- Health institutions
- Fishermen's associations
- Women's associations
- Neighborhood associations
- Tourist transportation cooperatives.

Table 18. List of Project Stakeholders-Governance and Control Institutions

Name	Cargo	Institution/ Organization
Alberto Velez Cevallos	Zonal Coordinator Loja-El Oro	Ministry of Environment and Water - MAAE
Clemente Bravo	Prefect	GAD Provincial de El Oro
Mario Leon	Coordinator	Secretary of Environmental Management GAD Provincial de El Oro
Dario Macas	Mayor	GAD Machala
Cristhian Cabrera Gia	Director	Directorate of Environmental and Risk Management GAD Machala
Yajaira Tandazo	Director	Directorate of Tourist and Cultural Development GAD Machala
Hugo Ruilova Perez	Chief	Fire Department of Machala Canton
Danilo Maridueña	Governor	Government of the Province of El Oro
Fabian Briceño	Chief	UPC Puerto Bolivar
Javier Tocto Palacios	Prosecutor	Prosecutor's Office Pto.
Leonardo Palomeque	Commander	Capitanía de Puerto Bolívar CAPBOL
Xavier Rubio Garcés	Commander	Coast Guard Sub Command SUBSUR
Romel Chiriboga	Director	Provincial Director of Agriculture and Livestock of El Oro
Hector Zambrano	Commissioner	Puerto Bolivar Municipal Police Station
Javier Astudillo Gómez	Zonal Coordinator	ECU 911 Machala
Evelyn Icaza Domínguez	Manager	Port Authority of Puerto Bolivar
Gorky Moscoso	Chairman	Puerto Bolivar Parish Council
Fabiola Briones	Coordinator	National Institute of Popular and Solidarity Economy

Prepared by: Ecosambito, 2020.

Table 19. List of Project stakeholders-Associations and neighborhoods.

Type	Name	Cargo	Institution/ Organization
Shrimp producer associations	Segundo Calderon	Chairman	El Oro Chamber of Shrimp Producers (PCO)
	Ufredo Coronel	Chairman	Asociación Productores Camaroneros Fronterizos de El Oro (ASOCAM) (El Oro Border Shrimp Producers Association)
Banana Guilds	Marianela Ubilla	Director	Association of banana exporters of Ecuador
			Banana Marketing and Export Association
Educational Institutions	Jefferson Saavedra	Rector	Victor Naranjo Fiallos Educational Unit
	Mercedes Orellana	Director	Sara Serrano de Maridueña School
	Mayra Paulina Murquincho Carrión	Coordinator	Universidad Técnica Particular de Loja - Machala Campus
Health institutions		Director	Municipal Medical Unit "Dr. Pomerio Cabrera".
			Puerto Bolivar Sub-Health Center MSP
Fishermen's, women's and craftsmen's associations	Danny Castellano	Chairman	President of UOPPAO
	Luis Calle	Chairman	La Playita de Jambelí Association
	Arturo Cruz	Chairman	Association of Self-Employed Shellfish Harvesters and Annexes "Venecia Del Mar".
	Bolivar Alvarado	Chairman	Coastal Fishermen's Association "24 de Junio".
	Edinson Pezo	Chairman	San Antonio" Artisanal Fishermen's and Related Associations
	Tarcila Cruz	Chairman	Association of Self-Employed Shellfish Harvesters and Annexes "Productos del Mar".
	Stalin Espinoza	Chairman	Association of Cangrejeros "17 de Enero".
	Renee Carrasco Santos	Chairman	Association of Self-Employed Cangrejeros "Amor y Esperanza" (Love and Hope).
	Pedro Lucas	Chairman	16 de Julio" Artisanal Fishermen's and Related Fishermen's Association
	Beczaida Tejada	Chairman	Los Isleños" Association of Shellfish Harvesters and Related
	Lorenzo Valiente	Chairman	Mar de Galilea Artisanal Fishermen's Association
	Martin Acosta Vera	Chairman	Asociación de Pescadores Artesanales y Afines 24 de Diciembre (Association of Artisanal and Related Fishermen 24 de Diciembre)
	Tania Cuenca	Chairman	Leonidas Plaza" Artisanal Fishing Production Cooperative
	Dionicio Cruz Pezo	Chairman	Cooperativa de Producción Pesquera Artesanal "Virgen del Cisne".
	Evelio Cedeño	Chairman	Artisanal Fishing Cooperative "Costa Azul".
	Pedro Mendoza Rivera	Chairman	Asociación de Mariscadores Y Afines Defensores Del Manglar
	Pablo Valiente Ramírez	Chairman	Los Preciados" Fishermen's and Shellfish Fishermen's Association
	Kleber Valdiviezo	Chairman	Dos Bocas Artisanal Fishermen Association
	Andrea Reyes	Chairman	Fishing Production Cooperative "Recolectores de Marisco Puerto Grande".
	Wellington Velez	Chairman	Shell Collectors Association "Ni Un Paso Atrás" (Not One Step Back)

Type	Name	Cargo	Institution/ Organization
	Luz Mena Valdiviezo	Chairman	Puerto Mar Fishing Production Cooperative Coopropesmar Coopropesmar
	Miguel Chalen Rivera	Chairman	Cooperativa de Pescadores Artesanales 14 De Junio Coopjun
	Eduardo Tevante	Chairman	Simon Bolivar Handicraft Production Cooperative
	Washington Oyola	Chairman	Cooperativa de Producción Y Comercialización Jesús El Gran Pescador "Cooprograp".
	Hugo Quinde	Chairman	Asociación de Mariscadores y Anexos (Shellfish Harvesters Association) January 11th
	Brenda Medina	Chairman	Artisanal Fishing Production Cooperative "Vikingos del Mar".
	Luis Merchan	Chairman	Asociación de Producción Pesquera Artesanal Puerto Jelí (Puerto Jelí Artisanal Fishing Production Association)
	Hugo Serrano	Chairman	Artisanal Fishermen's Association "19 de Octubre".
	Gabriel Jordan	Chairman	Bellavista Island Association
	Leopoldo De La Cruz	Chairman	Asociación de Producción Pesquera Artesanal Y Afines "10 De Agosto".
	Feliciano Potes Cruz	Chairman	Association of Seafood Harvesters "Archipiélago de Jambelí".
	Javier Jimbo	Chairman	Association of Artisanal Fishermen "Nuevo Milenio".
	Gabriel Suarez	Chairman	Asociación de Producción Pesquera de Recolectores de Mariscos Asoprorecmar (Association of Seafood Harvesters)
	Jose Salazar Cuzme	Chairman	Association of Shellfish Harvesters and Allied Workers "Divino Niño".
	Cesar Tejada	Chairman	Las Huacas Association of Concheros, Crustaceans and Artisanal and Related Fishermen
	Franklin Cruz	Chairman	Association of Artisanal Fishermen, Shellfish Harvesters and Similar "Costa Rica".
	Anibal Potes Pezo	Chairman	Autonomous Fishermen's Association and Annexes "9 De Octubre".
	Roberto Montes	Chairman	Association of Artisanal and Related Fishermen Bajo Alto
	Alberto Campos	Chairman	Association of Seafood and Seafood Collectors "24 De Octubre".
	Jose Ortega	Chairman	Artisanal Fishing Production Cooperative "Río Chaguana".
Women's associations	Rosa López Machuca	Coordinator	El Oro Women's Movement, MMO
	Rocio Reinoso Mite	Chairman	Association of Women Artisans "Estero Porteño".
Neighborhood associations	José Palas	Chairman	Simón Bolívar Neighborhood
	Ariosto Carchi Salazar	Chairman	Rafael Morán Valverde Neighborhood
	Maryuri Cruz	Chairman	La Unión Neighborhood
	Nuvia Chavez	Chairman	Harry Álvarez Neighborhood
	Roberth Diaz	Chairman	Pacific Quarter
	Oscar Correa	Vocal	Pacific Quarter

Type	Name	Cargo	Institution/ Organization
	Wilfrido Banchón	Chairman	5 de Diciembre Neighborhood
	William Ramirez	Chairman	Centenario Neighborhood
	Javier Ponguillo	Chairman	Puerto Nuevo Neighborhood
	Carlos Rosales	Chairman	Virgen del Cisne Neighborhood
	Pedro Chalén	Chairman	24 de Diciembre Neighborhood
	Dorian Rosero	Chairman	4 de Abril Neighborhood
	Fermín Alvarado	Chairman	Cdla. Venecia del Mar
	Carlos Espinel	Chairman	Atahualpa Neighborhood
	Manuel Granda	Chairman	Vencedores Neighborhood
	Bolivar Alvarado	Chairman	December 25th Neighborhood
	Eloy Cruz	Chairman	Bolivar Neighborhood
	Blanca Aldaz	Leader	La Unión Neighborhood
Tourist transport cooperatives	Betty Sanchez	Manager	Rafael Morán Valverde Cooperative
			July 31 Cooperative

Prepared by: Ecosambito, 2020.

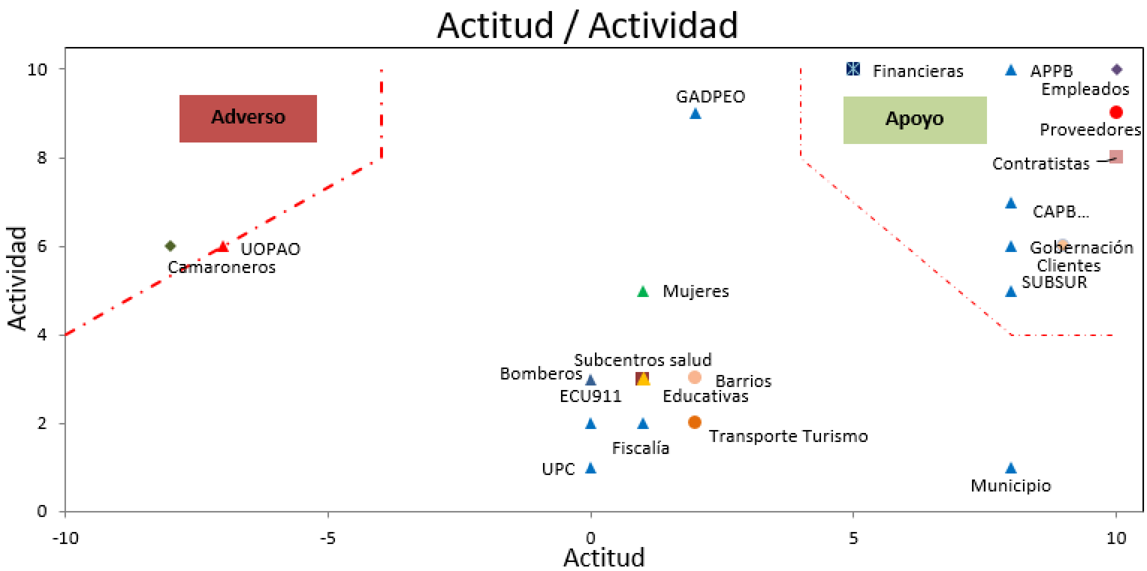
16.1. Stakeholder mapping

Stakeholder mapping is a representation that allows us to categorize stakeholders in a graphical representation that allows us to categorize graphically the level of interest and/or power that these groups have in relation to the project.
It is important to note that this mapping should be updated or redone whenever there is a substantial change in the project, or whenever necessary.

16.1.1. Attitude - Activity Matrix

The left reference line marks the point at which stakeholders are considered potentially adverse to the project. The reference line on the right marks the point at which stakeholders are considered likely to support the project. The challenge will be to appropriately manage the involvement of stakeholders who are in the area adverse to the project so that their perception of the project is improved.

Figure 20.. Attitude - Activity Matrix



Prepared by: Ecosambito, 2020.

16.1.2. Power - Interest Matrix

This technique groups stakeholders according to their level of authority (power), level of concern or desirability about project outcomes (interest).

The involvement of the different internal and external stakeholders will be planned according to the following classification:

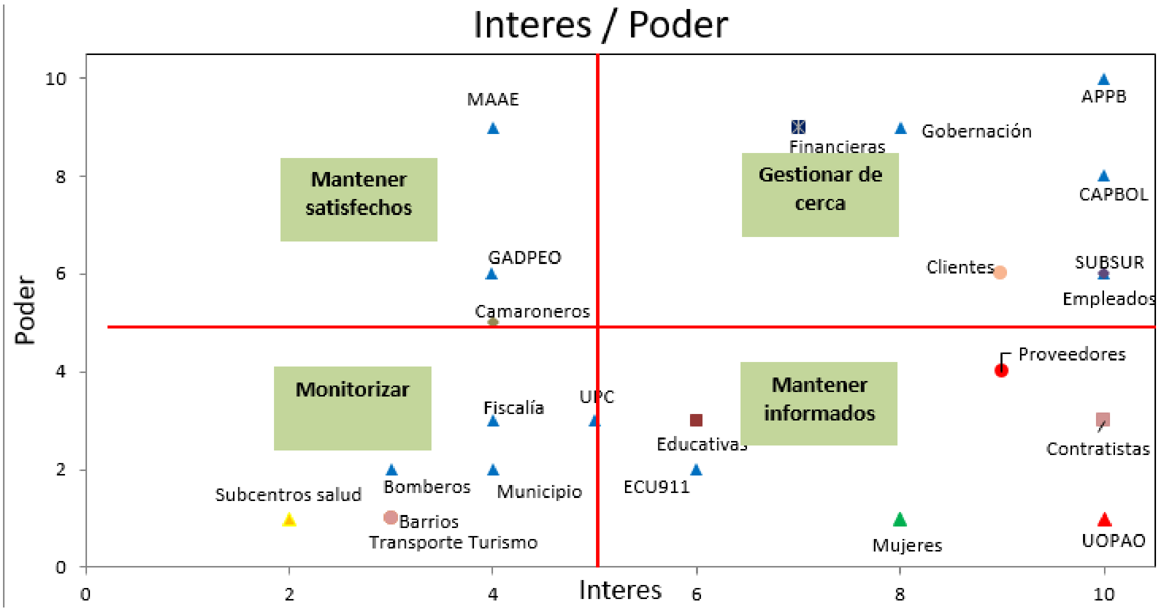
High interest - High power: manage very closely, as they can act as a source of opportunities and/or threats.

High interest - Low power: keep informed

Low interest - High power: keep satisfied, since sometimes we can find ourselves with a cancellation of the project that arises from someone with these characteristics.

Low interest - Low power: make as little effort as possible, in most cases it is enough to know how it evolves.

Figure 21. Power - Interest Matrix



Prepared by: Ecosambito, 2020.

16.2. Stakeholder management.

16.2.1. Roles and responsibilities in stakeholder management

Senior management shall establish mechanisms to manage stakeholders in a way that balances their expectations with those of the company. To this end, the environmental and social management plan shall establish the roles and responsibilities necessary to comply with stakeholder management.

16.3. Stakeholder communication and participation

Stakeholder communication and participation will be established for each group identified by its Stakeholder-Power. Thus, we will have four outreach strategies:

- Close Management
- Keeping satisfied
- Keeping informed
- Basic communication

Some of the communication and outreach strategies include direct and voluntary communication with stakeholders to be managed more closely, timely compliance with legal obligations, e.g. environmental regulations, perception and satisfaction surveys. Another strategy, for those parties to be kept informed, is publication in the press and other indirect media.

A complete list of communication and participation strategies is presented in the Environmental and Social Management Plan.

17. Community health and safety risk assessment

Performance Standard 4 contemplates that project activity, equipment and infrastructure may entail risks and impacts that leave a community exposed. Similarly, communities that are already subject to other impacts may experience an acceleration of these impacts due to project activity.

Therefore, it is necessary to assess the risks to the health and safety of the community due to the implementation of the project, in order to apply strategies to prevent and mitigate these impacts.

Anticipation and prevention of harmful impacts to the health and safety of affected communities can occur during and after a project.

17.1. Methodology

17.1.1. Health effects for the inhabitants of Puerto Bolivar

In the surveys conducted with the community surrounding the project, no fears or impressions of a negative impact on people were expressed. Responses regarding the possible disadvantages of the project focused on environmental risks and impacts on biodiversity, and therefore, on fishing of marine resources.

On the other hand, socioeconomic benefits derived from the project were identified, such as improved job opportunities, tourism and trade.

On the other hand, if we analyze the data on the health of the population (Chapter 8 and 15.1.6), there is no indication that the morbidity of the population is influenced by environmental effects, since the main causes of medical attention or morbidity are due to urinary tract infections and acute rhinopharyngitis [common cold].

17.2. Risks due to project activities.

Some of the risk factors that the project may exert on the population include:

Infrastructure design and safety. The location and location of the port's operational areas with respect to the terrain means that port activities and their emissions, such as noise and gases, are generated far from the populated area. However, the entry and exit of trucks does pose risks on Bolívar Madero Vargas Avenue, especially the risk of accidents with pedestrians, cyclists, and other vehicles, in addition to generating noise and dust that can affect residents and workers living in the area near the avenue.

Hazardous materials management and safety. Yilportecu stores and uses hazardous materials, mainly fuels, although this activity is carried out only for the use of specific machinery and equipment. Moreover, this storage is carried out under regulated conditions, so it does not represent a high risk.

Ecosystem services. The coastal marine ecosystem services near Puerto Bolívar are important: from fishing, bivalve and crustacean harvesting, to tourism and gastronomy. These services have not been affected by the operation of the Port Terminal, which has been operating there for several decades. Expansion and dredging activities could affect fishing on a temporary and ad hoc basis.

Community exposure to disease. As mentioned in the previous section (17.1.1), there does not appear to be evidence that Puerto Bolivar's morbidity is influenced by the Port Terminal's activities.

Emergency preparedness and response. Yilportecu has emergency response mechanisms in place. These include annual drills in which Yilportecu has participated with local security institutions such as ECU911 and the fire department. It is important to strengthen emergency response procedures with community participation.

Security personnel. Yikport receives private security services at its facilities and at the entrance. The security company that provides this service has annual training plans, with coverage of human rights and the rational use of force.

18. ANNEXES

APPENDIX 1. Systematization of Training Workshop

APPENDIX 2. Socio-Economic and Cultural Enquiry surveyed on-site

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PUERTO BOLÍVAR PROJECT - PHASE 1

- CULTURAL BASELINE (ARCHAEOLOGICAL DIAGNOSIS) -

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

This document contains an archaeological diagnosis of the project implementation area to be executed by Yilport Terminal Operations (YILPORTECU) S.A.

The methodology includes the review of technical reports submitted to the INPC-R7 (EIA - Study Projects) and printed documents (drawings, IGM letters, publications, etc.). A field phase was carried out with the pedestrian reconnaissance of the Port Terminal and the area of implementation of Dock 6. Based on the information collected, a preliminary map of archaeological sensitivity of the studied sector was drawn up.

In this study, the studies carried out by other archeology specialists on the past societies that settled in the vicinity of the observation area were summed up. This reference information let us know the state of the studies to date and locate probable sectors of archaeological interest, in order to estimate the greater or lesser sensitivity.

In the end, a Mitigation Plan and Archaeological Contingency Measures are presented.

ARCHAEOLOGICAL DIAGNOSIS

1. Archaeological background of the southern coast of Ecuador

The area of our study is located in the southern coast of Ecuador, which has had little archaeological studies, having as a close background the studies carried out by Estrada (1979); Christensen (1955); Estrada *et al.* 1964; Currie (1985); Staller (1992/93); Idrovo (1994); Zevallos (1995); Véliz (1996); Netherly (1988); López (2003, 2005, 2017), Rowe (2008); Vasquez *et al.* 2000; Delgado 2007; Vega *et al.* 2009; Almeida (2013) and others, in which pre-Hispanic vestiges were found.

Christensen (1955) carried out excavations in a funeral *tola* located in Hacienda La Esperanza, province of El Oro, and rescued cultural material of Milagro Quevedo origin, although the archaeologist had mistakenly associated it with the Manteño period.

Meggers (1966) mentions that the vestiges of the Jambelí phase were usually found in small shellfish dumps located in flooded lands that bordered inlets, rivers and swamps with an occupying power that rarely exceeded 50 cm below surface. He claims that, although their subsistence economy was based mainly on fishing, the discovery of stolica hooks also involved hunting activities. The hands and mills were used in the preparation of food.

In his publications, Estrada (1979) illustrates the presence of elevated mounds in the Balao and Machala sectors, which we were personally able to verify in the studies carried out at the Hacienda San José de Balao (López 2003).

In the late 1970s, the Tahuín Project (financed by the Central Bank of Guayaquil) began on the Arenillas River, surveying the Arenillas River, as well as surrounding areas, which allowed Netherly to define the tradition "Arenillas" and located it in the Late Formative period.[1] The survey allowed discovering sites of various periods (more than 500 sites), as well as determining settlement patterns, among the various sites located in the upper and middle valleys.

In the Guarumal shell-gathering sites (00-SR-SR-01) and in Punta Brava (00-AR-AR-318), Currie (1985) reports vestiges of Jambelí material, stating that "there is more than one culture associated with a tradition of small-scale use of coastal resources since pre-ceramic times, and the studies in the Arenillas river valley break the idea that the Jambelí sites mean an exclusive adaptation to the estuary and the mangrove." Guarumal, is represented by a group of shell mounds, located north of Santa Rosa, near Guarumal estuary. The site exhibited a long sequence but was in the process of destruction due to the creation of shrimp farms. Punta Brava, exhibited dense amounts of Jambelí material. Unlike the previous one, this site was located towards the interior of the mangrove line, on the top of a small elevation, close

[1] Netherly 1988.

to Arenillas. Idrovo (1994) reports Jambelí material (ceramic, obsidian, and copper plates) rescued from an elite tomb in Guarumales, a site previously studied by Currie.

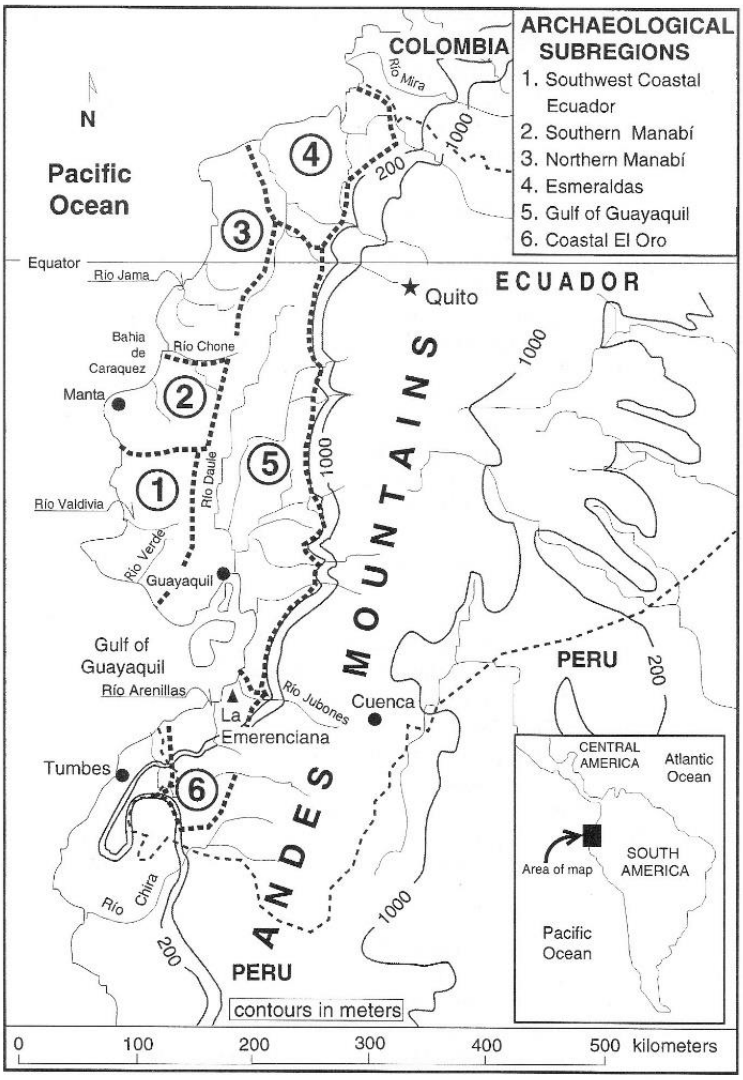
The presence of sites of the Pechiche and Garbanzal cultures, in the now arid region of Tumbes, can be considered within the context of probable climatic changes during recent periods, with the implication that this region once supported the mangrove forest within a forest more humid than the current one.

In turn, Staller (1992/93, 2000, 2001), in the excavations carried out at the La Emerenciana site, obtained cultural material associated with the Early Formative period, identifying a hierarchical pattern in the distribution of the sites for this period. La Emerenciana is located in what the author has called 'archaeological subregion 6,[2] coast of El Oro'. This archaeologist claims that the cultural sequence of El Oro begins in the Early Formative period with Valdivia, continuing the sequence with the Machalilla culture located in the Middle Formative period, with the Chorrera culture for the Late Formative period, continuing with the Jambelí culture for the Regional Development period, probably culminating in the Milagro-Quevedo (Chono) culture.

Staller mentions that sub-region 6 (coastal sector of the province of El Oro) refers to "……to the barrier island estuary of the Straits of Jambelí, specifically the area between the Jubones River near the city of Machala, and the border of Peru at the Zarumilla river"(Staller 2001:200, Figure 1).

[2] Staller J. 2001:199, fig 2.

Figure 1. Subregion 6 (coast of El Oro)



Source Staller 2001:199

At the Cañas site located on the right bank of the Arenillas River, Staller[3] found diagnostic material which he associated with the Valdivia-Machalilla transition, but then Stothert[4] later placed it as belonging to the Regional Development Period (Guangala).

Zevallos (1995) refers to what he called the southern sector of the Guayas Basin, as a sector with the greatest and most notable cultural advancement, both in artistic and technological terms. Precisely the largest number of unique artifacts due to their beauty, conception, and symbolism, which made up the CCENG gold collection in its time, came from the southern sector of the Basin (Balao sector).

Vásquez *et al.* (2000) reported a Jambelí settlement in the impact area of the Amistad field platform, Block 3. They reported discoveries of pot fragments of moderately large size,

[3] Staller J 1992-93
[4] Stothert K 1990

polypods of considerable size that indicated the presence of large vessels. A hand and a hammer were also recovered on the surface of the Chaguano site, which is made up of a shellfish-gathering site with the *Cassostrea* species, which formed a fundamental part of its diet.

In the studies carried out at the Hacienda San José, in the Balao parish, López (2003) reports the presence of elevated mounds, of different heights, most of them with a strong anthropic impact originated in the construction of banana and shrimp farms, all of them of Milagro-Quevedo origin. One of the preserved mounds (multi-occupational) exhibited evidence of a Milagro-Quevedo housing structure, under which vestiges of the Jambelí culture were found. An interesting aspect was discovery evidence of a metalworking workshop in the Chono housing unit.

In the layout of the Milagro-Machala Electric Transmission Line (López 2005), the presence of several settlements of Milagro-Quevedo (MQ) origin was reported, many of them with great anthropic impact due to agricultural work. One of these reported evidences was approximately 300 m from a settlement with Tola mentioned later by Delgado (2007).

Delgado (2007) reported the presence of six settlements with *tolas*, close to the town of Ponce Enríquez. This archaeologist mentions that it is located between "… the Fermín river and the plain bathed by the Tenguel river up to Santa Martha to the northeast and the entrance to Tenguel to the southwest, it was intensely occupied by a series of human settlements perhaps under a single complex political leadership (caciquism)." (Delgado 2007)

In the excavations carried out at the El Dornajo[5] site near Chacras, made up of three mounds, several burial patterns were found and, according to Rowe, it was occupied after an "environmental phenomenon" (El Niño). The site with the presence of public architecture "seems to be the center of a pre-Hispanic chiefdom from 300 to 1400 AD." The presence of mounds in the vicinity of the Arenillas river allows ratifying the expansion of Chono chiefdoms, in addition to a trade network through the river mentioned above.

2. Archaeological background in the study sector

In the late 1950s, Estrada *et al.* (1964) carry out a survey on the islands of Jambelí. Jambelí cultural material had previously been reported in Tendales. As for the southern coast of our country, the archaeologists mention that:

"The distribution and character of the Jambelí Phase sites indicates that the southern portion of the area conserves the appearance that the northern portion must also have presented around the beginning of the Christian Era. The mangrove islands extend at the present time from the Peruvian border northeastward to the vicinity of Machala along the coast of El Oro province." (1964: Figure 2).

They[6] mention that all Jambelí sites are shellfish dumps, the most common species being *Ostrea columbiensis*. Usually most of the sites present 50-cm thick accumulations, although others (G-86) presented up to 160-cm thick accumulations, scrambled with pots, with

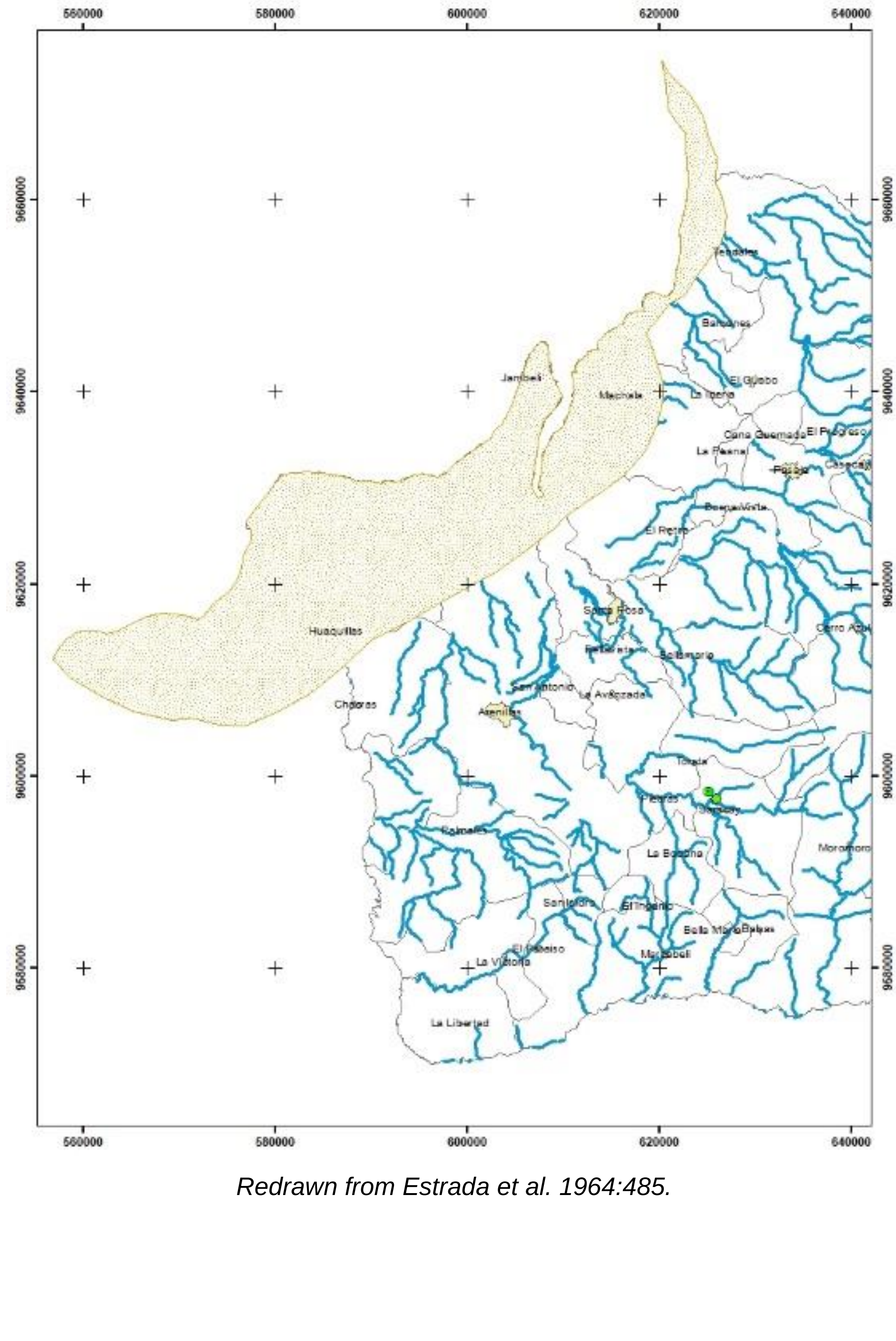
[5] Taylor S. 2008

[6] Estrada, Meggers & Evans, 1964.

settlements that occupy areas of 6000 m², although most of the sites fluctuate from 10 to 30 meters in diameter, with cultural evidence ranging from a depth of 20 to 40 cm.

In terms of the current environmental situation, the Jambelí sites are divided into two groups, those on the margins of the saltpeters and those of the active mangroves. Some of the Jambelí sites on Puná Island and all of the islands in province of El Oro are located in small areas of highlands scattered over what are predominantly mangrove swamps. Only three sites had sufficient deposit depth and were calm enough to allow stratigraphic excavation.

Figure 2. Estrada, Meggers and Evans illustrated the approximate geographic spread of the Jambelí culture (orange dotted line).



Redrawn from Estrada et al. 1964:485.

The archaeological site called Embarcadero is located about 5 km inland from the El Embarcadero estuary, where the left bank rises 2 m above the level of high tide. Shellfish debris was visible at a distance of about 150 m along this bank. The rubbish areas descend into the surrounding land, which gets approximately 1 m above high tide, an outline that is easily seen from the water. Along the eroded bank, vertical columns made of shells of about 10 cm in diameter and about a meter long could be seen in various places, possibly representing ancient post holes. The site is thickly covered, but the dump can be traced 30-40 m inward from the bank. In cross-section 1, sherds were found at a depth of 80 cm, where a dense layer of shells (20-25 cm thick) was found, and there was a sticky clay below, the natural soil of the bank. The only unusual artifacts were a ceramic statuette arm from level 20 to 40 cm and another statuette fragment from level 40 to 60 cm.

Figure 3. . Archaeological sites reported by Estrada, Meggers and Evans on the coast of the province of El Oro.

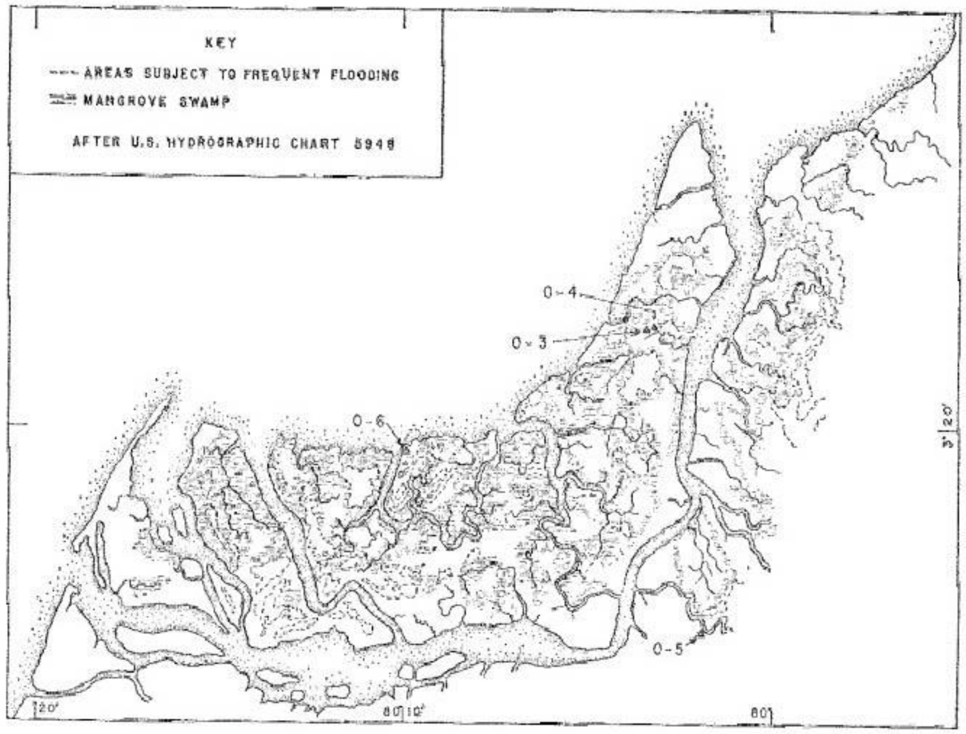


FIGURE 4.—Map of the coast of El Oro Province, showing distribution of mangrove swamp and location of Jambelí Phase sites.

Jambelí sites with ceramics in the province of El Oro (Figure 3):

- O3: Chiveria Estuary N1
- O4: Chiveria Estuary N2
- O5: Embarcadero
- O6: Las Huacas

- O7: Tendales

Initially Estrada *et al.* (1964) believed that all Jambelí culture sites were shell formations. However, in the late 1970s, sites were reported inland on the tops of low hills (Currie E. 1985, 1989).

3. Ethnohistoric Studies of the Area

The geographical area of the Chonos, called Daulis by the Spaniards, according to various documents from the General Archive of the Indies in Seville, made up a wide territory that encompassed several provinces of present-day Ecuador.

The Chonos, archaeologically identified as Milagro-Quevedo, occupied a vast area in the river basin of the Daule and the Guayas, ranging from the bases of the mountain range to the Jambelí channel, beyond Quevedo and Baba, up to the borders with the Niguas and Caráquez[7] (Figure 4).

Studies carried out during these last decades have made it possible to further expand the territory they occupied towards the south,[8] reporting traces of settlements near Machala (López 2005, image 4).

In this regard, Holm[9] mentions that the Chono territory encompassed the entire Guayas river system, setting its boundaries to the north with the Atacames culture, on the heights of Santo Domingo; on the eastern side with the foothills of the Western Cordillera, in the current provinces of Pichincha, Cotopaxi, Chimborazo, Bolívar, Cañar and Azuay; on the south side on the coasts of the province of El Oro, where it merges with the southern extension of the Manteña-Guancavilca culture, except for the Puná island.

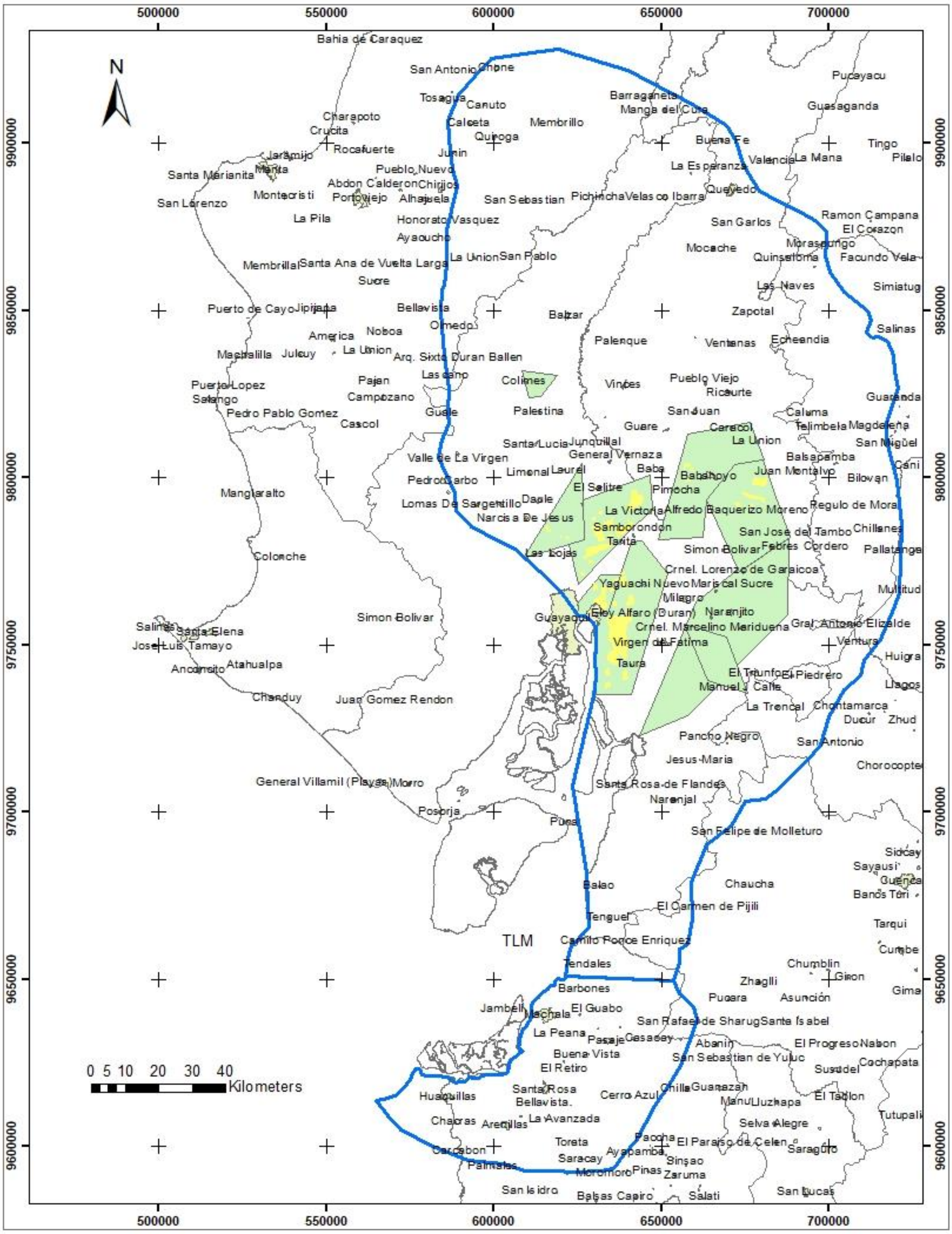
In the 15th and 16th centuries, the caciquism or lordship of Chono had a ‘capaccuraca’ and “many chiefs were subordinated to this position.” All the chiefs dependent on him provided the income he required for his maintenance and practices of generosity and hospitality. Income included fruits of the earth in appreciable quantity and of the best quality.

The prestige of the chiefs of the Chono kingdom, called Daule by the Spaniards, was actually quite notorious not only because it encompassed the entire basin of the Amay River, Guayas at present times, and the land that extends north and south of it.

Their housing centers were generally located on the coastal beaches and on the riverbanks, which the Chonos used as means of communication. Their houses and villages were built on hills of land that were high enough to emerge as islands, around which they had abundance of farms and orchards where they cultivated their subsistence food. Many of its houses were built following a ‘barbecue style’, with room for only one person. They also built fortified enclosures, possibly shrines.

[7] Espinoza Soriano W., 1981
[8] Taylor S. 2011.
[9] Holm O. 1983

Figure 4. Chono occupation area in the Guayas river basin in blue line. Elevated field systems and platforms in green and yellow polygons



Espinoza Soriano, 1981:11; Denevan & Mathewson 1983:170.

The Chonos were traditional enemies of the inhabitants of Puná Island, with whom they fought constant wars at sea. They also had wars with the Tumbesinos. In the last phase of the Chono kingdom, artificial mounds abounded, indicating a considerable population density. The niches of their tombs were largely occupying these artificial mounds, which had urns of different size, number, and arrangement. The large mounds contained a large number of niches, which included direct burials, urns covered with lids, and chimney-type urns, most of which were accompanied by varied burial goods.

Their household dishes were made of metal, ceramic, stone, and bone. In metallurgy, they reached the most intense development on the coast, working with gold, silver, and copper, making an infinity of sumptuous artifacts in addition to ornaments. The most beautiful collections of Milagro gold jewelry were kept in the Gold Museum of the *Casa de la Cultura Núcleo del Guayas*. The frequent use of gold wire not only as a constructive element, but also for the beautification of jewels, was characteristic of the distinguished goldsmiths of this culture.

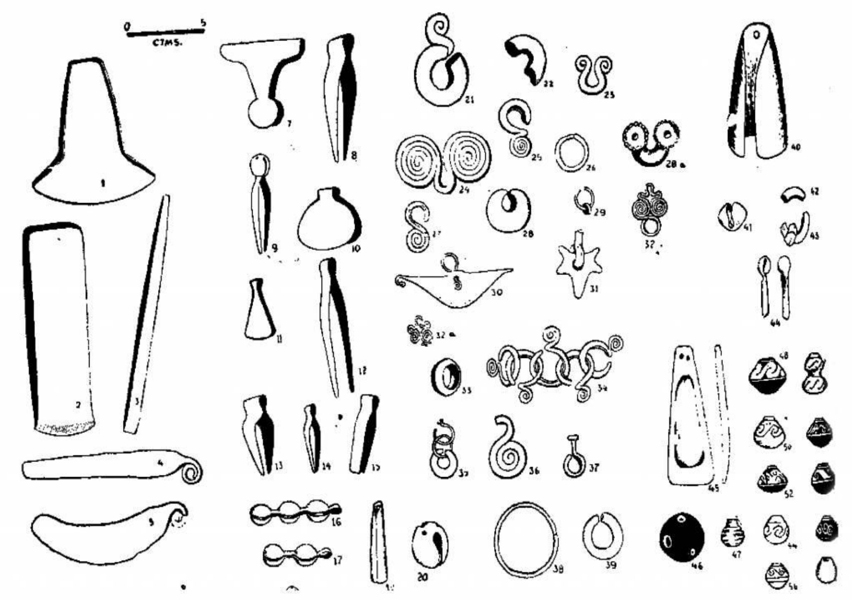
Dora León (1964) mentions that the Chonos occupied a vast extension in the fluvial area of the Ecuadorian coast, reaching the provinces of Esmeraldas and El Oro. They apparently originated in the Amazon region.

Szaszdi *et al.* (1980) mention that Juan de Salazar Villasante, BArch, claims that the Chono rafters “were naked, only wearing loincloths.” Various sources claim that the Chonos wove cotton blankets (Figure 5).

Figure 5. Chono blanket design, based on the photograph of the textile fragment found in a grave reproduced by B. Meggers.

As for the jewels worn by the Chonos, the ethnohistoric sources tell us nothing. On the other hand, the information provided by archaeological works is abundant, in which necklaces, nose rings and earrings of copper, silver and gold are mentioned. Preferably they used spiral-shaped wire to make various ornaments (Figure 6).

Figure 6. Artifacts and various ornaments.



Source: Estrada 1979:26.

4. Theoretical framework of the study

Archaeological studies in recent decades have let us know more aspects (occupation patterns, social complexity, socioeconomic formation) about the ancient pre-Hispanic cultures in our country, which has partially revealed the cognitive structures that are sustained in their way of life, ideology, technological processes, beliefs, and historical changes through time.

For this reason, the vestiges (architectural and decorative) found in the surveys and excavations are the fundamental elements to reconstruct the life forms of the group that made them. Thus, the archaeological study or intervention must be carried out with the purpose of recovering the greatest amount of information to reconstruct the history of cultures that have been transformed or have disappeared.

The reconstruction of forms of life implies getting to know the culture of the social conglomerates. Culture is understood as the set of parameters through which the reality in which individuals develop is assimilable and controllable, where all customs, traditions, legends, forms of interaction with the environment are incorporated, that is, everything what is inherited in a non-biological way.[10]

With this theoretical basis, the purpose is to identify the pre-Hispanic settlement patterns that exist in the area of interest, which should reflect indicators of temporality identified on the coasts of the province of El Oro and the coasts of northern Peru.

[10] Hernando A., 2002.

5. Methodology

An archaeological diagnosis is considered to be:

"A systematic surface recognition with or without collection of paleontological or archaeological material, with or without excavations, that allows planning actions, programs and study projects in a territory under study.[11]*"*

The information reviewed was found in:

- Technical reports presented to the INPC-R7 (EIA - Study Projects).
- Printed documents (plans, IGM letters, publications, etc.).
- A pedestrian reconnaissance of the Port Terminal and the location of Dock 6 was carried out.
- Based on the information collected, a preliminary map of archaeological sensitivity of the studied sector was drawn up.

In this study, the studies carried out by other archeology specialists on the past societies that settled in the vicinity of the observation area were summed up. This reference information let us know the state of the studies to date and locate probable sectors of archaeological interest, in order to estimate the greater or lesser sensitivity.

5.1. Archaeological sites closest to the study area

In the vicinity of the evaluated area, we will mention the sites that have been reported at a distance of approximately 6 km (Table 1):

[11] Echeverría J. 2011

Table 1. Archaeological sites near the Port Terminal.

East	North	Code/Name	Type	Origin
605416	9636477	Chiveria Estuary 2	Housing	Jambelí
605054	9636490	Chiveria Estuary 1	Housing	Jambelí
613541	9637635	La Puntilla	Housing	Jambelí
617504	9641303	La Primavera	Housing	Jambelí
617882	9640536	Los Vergeles	Housing	Jambelí

Compiled by author

6. Archaeological Mitigation Plan

The mitigation measures (see Table 1) are linked to the construction phase of Dock 6, dredging activities and other works considered in the implementation of Phase I:

- The period of time the construction will take and,
- The protection of the potential heritage assets to be affected, directly or indirectly.

They will be aimed at being carried out using the following criteria:

1. Anticipate potential impacts,
2. Minimize impacts as much as possible and,
3. Mitigate through study.

The area where the construction works of Dock 6 and other works considered in the implementation of Phase I will be carried out, as well as several sectors of the Port Terminal, are close to pre-Hispanic settlements both in the island sector, as well as in the land sector and the interior of an area reported in the middle of the last century, as a sector of interaction of the Jambelí culture (Regional Development period 30 BC - 70 AD),[12] but these have also been filled up with soil and stone material for soil compaction over decades.

Within the process of obtaining the Environmental Licenses and Environmental Registry, an assessment or certificate of Cultural Heritage were not required by the pertinent authorities.

[12]Obelic B.& J.G.Marcos 1997.

Table 2. Archaeological Mitigation Plan

Action	Potential Impact	Action to Take
1. Construction of Dock 6	Low probability of vestiges on the beach	“If during the construction phase, the builder and/or the inspection is faced with unexpected situations, a team specialized in archeology is required to determine whether the material found…”
2. Project Closure	No alteration	In the event that the dock is no longer working, the intervened area and surrounding area must be left in adequate conditions, free of debris and pollutants.

Prepared by: Ecosambito, 2020.

7. Archaeological Contingency Measures

The measures proposed here are aimed at taking action in unexpected situations.

- ✓ In the event of facing a potential discovery of cultural material during the construction process, these must be fully identified to get to know their origin, and a team specialized in archeology must be hired to determine if the discovered material meets the conditions to be classified as cultural material.
- ✓ In the event that the team specialized in archaeological material determines that the discovery is cultural material, this event must be notified to the competent authorities.
- ✓ Make employees aware of how to proceed in the event of discoveries of cultural material.

8. Conclusions

As already mentioned in previous sections, due to ethnohistorical references and archaeological studies, on the southern coast of Ecuador, remnants of pre-Hispanic settlements have been reported and date back to the Formative period (Valdivia), passing through Regional development period (Jambelí) extending to the Integration (Milagro - Quevedo) period. Towards the north and east of the Port Terminal of Puerto Bolívar, vestiges of late pre-Hispanic settlements are still visible, although a large part of them have been impacted and destroyed by current human occupations, formal and informal settlements, civil infrastructure works as well as crops., generally combined with the natural processes over time (processes of cultural and natural transformation; Schiffer 1987). Currently adjacent to the Puerto Bolívar Terminal, a new situation has arisen with the invasion of families in an old sector of shrimp farms, the so-called Virgen del Cisne neighborhood (Source www.eluniverso.com/noticias 2020).

The high presence of late settlements linked to the Chono culture is related to the development of caciquism societies that established control and management systems through the modification of the landscape, with construction of elevated mounds, ridges, platforms,[13] etc., which required a huge labor force during its construction and maintenance, as well as a great knowledge of hydraulics. These constructions are related to intensive cultivation, with methods of maintaining soil fertility, and with at least dense populations in the localities where these configurations are found (Figure 9 in annexes). The reported sites revealed deep, as well as late, settlements, characterized by a ceramic assemblage that is closely related to what has been archaeologically defined as Milagro-Quevedo.

In this regard, Muse (1989:191) mentions that given the “diversity of borders shared by the Chonos and the formidable agricultural activity they developed through the construction of elevated fields, it is not difficult to imagine their key role in the production and distribution of so many basic material elements in the daily life of the western region and beyond (corn, yucca, balsa wood, bamboo cane, fish, game, cotton, textiles, copper products, coca).”

In the Tahuín dam, Almeida (2013) mentions that the ancient inhabitants of the Arenillas sites, despite being distant from the coastline (approximately 10 km), had the marine resource for their subsistence, which explained the presence of large dumps with malacological remains. At Hacienda Veintimilla, a large settlement associated with the Late Formative period was reported, although there also settlements associated with the Regional Development and Integration periods.

Based on the information obtained, we can indicate the following:

- The archaeological record indicates a permanent occupation dating back from the Formative to Integration (3700 BP) periods.
- Presence of multi-component settlements with deep deposits.
- Presence of settlements different in shape, size, function, and importance.
- Vestiges include concentrations of ceramic or malacological materials in flat spaces and concentrations of sherds in monumental structures (ridges and elevated mounds).

[13] Denevan et al. 1983, Parson et al. 1982.

9. References

ALMEIDA, Eduardo. Diagnóstico Arqueológico para los Estudios del proyecto Multipropósito Tahuín, Fase de Factibilidad. Unpublished report submitted to INPC. 2013.

CAÑADAS, Luis. Mapa Bioclimatico y Ecológico del Ecuador MAG-PRONAREG. Quito: Banco Central del Ecuador, 1983. 210p

CHRISTIANSEN, Ross. Una excavación reciente, en la costa meridional del Ecuador en Cuadernos Historia y Arqueología V5 Nos 13-14. Guayaquil : CCE Núcleo del Guayas 1955. p 83-92

CURRIE, Elizabeth. La Cultura Jambelí con referencia particular al conchero Guarumal en Memorias del Primer Simposio Europeo sobre Antropología del Ecuador. Segundo Moreno Yánez (comp.). Quito: Edic. Abya Yala. 1985. p 31-60.

CURRIE, Elizabeth. Cultural Relationships in Southern Ecuador 300 bC-AD 300: excavations at the Guarumal and Punta Brava sites. Thesis submitted for the degree of PhD, in fulfilment of the requirements for the degree of doctor of Philosophy in the Faculty of Arts at the Institute of Archaeology, University College, University of London. 1989.

DENEVAN W & K MATHEWSON. Preliminary Results of the Samborondón Raised Fields Project, Guayas Basin, Ecuador en J..Darch (eds) Drained Fields agricultural in Central and South America. British Archaeological Reports International Serie No. 189 pp 167-181; 1983.

ECHEVERRÏA, José. Glosario de Arqueología y Temas Afines. Convenio de Cooperación Interinstitucional entre el Municipio del Distrito Metropolitano de Quito y el Instituto Nacional de Patrimonio Cultural. Quito, 2011.

ESPINOZA SORIANO, Waldemar. El Reino de los Chono, al este de Guayaquil (Siglos XV – XVII). El testimonio de la arqueología y la etnohistoria. Lima. Separata de la Revista de Historia y Cultura Nos. 13-14, 1981. 60p

ESTRADA, Emilio. Ultimas Civilizaciones Prehistóricas de la Cuenca del Río Guayas. Publicaciones del Museo Víctor Emilio Estrada 2, Guayaquil, 1957b. 87p

HOLM, Olaf. Cultura Milagro-Quevedo. Publicaciones de divulgación popular del Museo Antropológico y Pinacoteca del Banco Central del Ecuador, Guayaquil. 1983.

Estrada Emilio, MEGGERS Betty & EVANS Clifford. The Jambelí culture of South Coastal Ecuador. Proceedings of the United States National Museum, Smithsonian Institution, Washington, D.C. N0. 3492 Vol. 115 pp. 448-558, 1964.

IDROVO, Jaime. Santuarios y Conchales en la Provincia de El Oro aproximaciones arqueológicas. Casa Cultura Ecuatoriana Núcleo de El Oro, 1994. p

INEFAN / FUNDACIÓN NATURA. Plan de Manejo Reserva Ecológica Manglares Churute, Fase 1, 4 Volumes, Guayas. 1996.

LEON BORJA, Dora. Prehistoria de la Costa Ecuatoriana. Anuarios de Estudios Americanos. TXXI. Sevilla, España. 1964.

LEON BORJA, Dora. Prehistoria de la Costa Ecuatoriana. Actas y Memorias XXXVI. Congreso Internacional de Americanistas. Sevilla, España. 1966

LOPEZ, Telmo. Informe Preliminar del Proyecto de Rescate Arqueología de Balao, Hacienda San José, Sitio Parazul. Report submitted to INPC, Subdirección Regional del Litoral, 2003. 47p

LOPEZ, Telmo. Informe de Diagnóstico Arqueológico en la Línea de Transmisión Eléctrica Milagro – Machala a 230 Kv. EIAD Expost. Report submitted to INPC, Subdirección Regional del Litoral, 2005. 55p

LOPEZ, Telmo. Prospección Arqueológica: Proyecto Línea de Transmisión Bajo Alto – San Idelfonso a 230 Kv, provincia de El Oro. Report submitted to INPC, Regional 7, 2017. 52p

MORENO, Segundo. Formaciones Políticas Tribales y Señoríos Étnicos en Nueva Historia del Ecuador: Epoca Aborigen II, V2, E. Ayala (ed) Corporación Editora Nacional, Quito. 1988

MEGGERS, Betty. Ancient Peoples and Places, Ecuador. London, Thames and Hudson, 1966. 220p

MUSE, Michael. Relaciones interculturales en el Área Ecuatorial del Pacífico durante la época precolombina: Proceedings 146 Congreso Internacional de Americanistas, Amsterdam, Netherlans, 1988. Editado por J.F. Bouchard y M. Guinea. 1989.

NETHERLY, Patricia. Arqueología a la sombra de la Presa Tahuin: Un programa de rescate en la provincia de El Oro. Report submitted to Museo Arqueológico. Banco Central del Ecuador. Guayaquil.

PARSONS J. & R. SHLEMON. Nuevo informe sobre los campos elevados prehistóricos de la Cuenca del Guayas, Ecuador. Miscelánea Antropológica Ecuatoriana 2:31-37. Guayaquil, 1982.

TAYLOR, Sarah. Informe preliminar del proyecto arqueológico Zarumilla (Paz). Sitio el Dornajo, provincia de El Oro. Report submitted to INPC. 2008.

TAYLOR Sarah. Condition of Social Change at El Dornajo, Southwestern Ecuador. Submitted to the Graduate Faculty of The University of Pittsburgh in partial fulfillment of the requirements for the degree of Doctor of Philosophy. University of Pittsburgh. 2011.

STALLER, John. El sitio Valdivia Tardío de la Emerenciana en la Costa Sur del Ecuador y su significación del desarrollo de complejidad en la costa oeste de Sudamérica. CHA Parte 1, V 46-47, CCE Núcleo del Guayas, 1992-93. p 14-37.

STALLER, John. The Jelí Phase Complex at La Emerenciana, a late Valdivia site in southern El Oro Province, Ecuador. In Andean Past, Vol 6, Cornell University, Latin American Studies Program, pp. 117-174.

STALLER, John. Reassessing the Developmental and Chronological Relationships of the Formative of Coastal Ecuador. Journal of World Prehistory, Vol 15, No.2, 2001.

SZASZDI Adam & Dora LEON BORJA. Atavíos y joyas de los pueblos balseros. En cuadernos Prehispánicos 8. Valladolid, pg 5 -52.

VASQUEZ J. & F. DELGADO. Prospección Arqueológica de la vía y de la Plataforma del Campo Amistad, Bloque 3, Provincia del Oro. Report submitted to INPC, Subdirección regional del Litoral, 2000. 30p

SCHIFFER, Michael. Formation Processes of the Archaeological Record. University of New México Press. Alburquerque. 1987.

TOBAR, Oswaldo. Prospección Arqueológica en los vértices del trazado de la Línea de Trasmisión de 230 Kv Milagro-Frontera con el Perú (lado ecuatoriano), provincias del Guayas y El Oro. Report submitted to INPC. Dirección del Litoral, 2003. 31p

VEGA Byron & John BARTON. Informe de prospección arqueológica de la provincia del Guayas y de El Oro. Proyecto sísmica 2D del litoral. Report submitted to INPCZ5.

ZEVALLOS M, Carlos. Nuestras Raíces Guancavilcas. Casa de la Cultura Ecuatoriana Benjamín Carrión, Núcleo del Guayas, Guayaquil, 1995.