Contributions to the validation of the joint methodology for the evaluation of solid waste on tourist beaches (RSPT) in the provinces of Guayas and Santa Elena, Ecuador.



Aportes a la validación de la metodología conjunta para evaluación de residuos sólidos en playas turísticas (RSPT) en las provincias de Guayas y Santa Elena, Ecuador

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Abstract: The results of the contributions to the validation of the PROPLAYAS methodology for the evaluation of Solid Waste in Tourist Beaches (RSPT), supported by the use of mobile devices, in 18 tourist beaches of the coastal provinces of Guayas and Santa Elena, of Ecuador are presented. The validation measurements were carried out between February and April, high tourist season, and June to September 2019, low season. Common wastes are the most frequent, being present in 100% of the beaches, but most of them correspond to the degree of "A" rating which, according to the RSPT methodology, is awarded to the cleanest beaches. The five grades proposed by the methodology range from "A" to "E", the latter being the one assigned to beaches with the highest presence of RSPT. Four beaches: Subida Alta, Bellavista and Cauchiche, on Puná Island; as well as Puerto Engabao, reported residues in valuation "D". Two beaches registered category "E", Subida Alta in the feces typology and Cauchiche in oils. The least frequent residues were coarse and oil, which only appeared the first in the Subida Alta and Alta beach and the last in Cauchiche, respectively. Montañita and Punta Blanca, reported residues in valuation "C" for: potentially dangerous and non-bulky vegetable residues, respectively.

The particular patterns of beaches with respect to the generation of RSPT for the 14 beaches in the cantons of Playas, Salinas, Santa Elena and Guayaquil (Varadero), are of local origin, a product of tourist activity, while the 4 beaches of the canton Guayaquil, Isla Puná Parish, are of external origin, possibly comin g from the city of Guayaquil and brought to the island by the Guayas River and the tide of the Pacific Ocean.

Keywords: PROPLAYAS, Solid Waste, Tourist Beaches, Ecuador, waste types.

**Resumen:** Se presentan los resultados de los aportes a la validación de la metodología PROPLAYAS para evaluación de Residuos Sólidos en Playas Turísticas (RSPT), soportada en utilización de dispositivos móviles, en 18 playas de las provincias



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de Guayas y Santa Elena, Ecuador. La validación se realizó entre febrero y abril, temporada alta, y junio a septiembre de 2019, temporada baja. La metodología aplica 5 categorías de "A" a "E", siendo esta última asignada a playas con mayor presencia de RS (residuos sólidos). Los residuos comunes están presentes en el 100% de las playas, mayormente con valoración "A" correspondiente a las playas más limpias. Cuatro playas en la isla Puná y Puerto Engabao, Playas, obtuvieron valoración "D". Dos playas registraron categoría "E", Subida Alta en tipología Heces y Cauchiche en Aceites. Los residuos menos frecuentes fueron los Gruesos y los Aceites, apareciendo en Subida Alta y Cauchiche, respectivamente. Montañita y Punta Blanca, reportaron valoración "C" para: Potencialmente peligrosos y Vegetales no voluminosos, respectivamente. La generación de RS para las 14 playas continentales es de origen local, producto de la actividad turística, mientras que en las de Puná, es de origen externo, provenientes de la ciudad de Guayaquil y llevadas a la isla por las corrientes de marea.

**Palabras clave:** PROPLAYAS, Residuos Sólidos, Playas Turísticas, Ecuador, tipos de residuos.

## Introduction

The generation of solid waste has become one of today's major environmental problems, from which Ecuador's beaches have not escaped. Thus, in the last 20 years hundreds of scientific articles have been published diagnosing this reality, in the five continents. Despite these efforts, there is no scientifically validated methodology to evaluate the amount and type of solid waste found on the beaches of Latin America, given the coordination and cooperation effort required. (Botero & Tamayo, 2021).

For the case of Ecuador on the subject of litter assessment, *Mestanza et al.*, (2019) published the baseline characterization of litter on 59 beaches in Ecuador, on beaches in the coastal region provinces of Esmeraldas, Manabí and Santa Elena and the island province of Galapagos. This study concludes that the Galapagos beaches are excellent and that the worst, in terms of litter content and abundance, are the beaches in the coastal region of Esmeraldas, Manabi and Santa Elena and the island province of Galapagos. The study concludes that the Galapagos beaches are excellent and that the worst in terms of litter content and abundance are those in the provinces of Esmeraldas and Santa Elena.

Likewise, Mestanza-Ramón *et al.*, (2020)In addition, they analyze the potential of Ecuador's tourist beaches in relation to sand, sun and sea tourism, in beaches of the mainland of Ecuador and Galapagos. territory Ecuador and Galapagos; evaluate 8 beaches in the province of Santa Elena, 5 of which correspond to the present study, on solid waste and conclude that the greatest tourism potential is found, in addition to the beaches of Galapagos, in the northern provinces of the Ecuadorian coast of Santa Elena, Manabí and Esmeraldas.

Another scenic evaluation of the coasts of mainland Ecuador and the Galapagos Islands indicates that the beaches of the provinces of El Oro and Guayas were not evaluated due to their high concentration of mangrove ecosystems and negligible number of tourist beaches. It is important to note that Playa Rosada and Olón were rated as having a high potential for certification. (Mestanza-Ramón, Anfuso, *et al.*, 2020)..

Finally, an inter-institutional study, coordinated by the National Fisheries Institute, evaluated trash on Ecuador's beaches. They sampled 25 beaches in the 5 coastal provinces and the insular province, among the results were the predominance of 60% of plastics and that the proportion of plastics in the garbage of anthropogenic origin are higher on the beaches near the Gulf of Guayaquil, suggesting that many of those plastic garbage may have been transported The results suggest that many of these plastic wastes may have been deposited in the Guayas River and that the other sources of beach litter are of local origin. (Gaibor *et al.*, 2020)..

Ecuador is a maritime country with five times more territory in jurisdictional waters than in terrestrial spaces, which is why it is very important for the country to sustainably manage its beaches, both those with tourist use and those with other potential for use and valuation.

Botero & Cabrera (2019), mention that the PROPLAYAS Network started operating in 2007, in the Mexican Riviera Maya with an ambitious work projection, very focused on the development of a conceptual-methodological basis and a set of practical applications for the integrated management and certification of tourist beaches (As cited in. Roca *et al.*, 2019). As part of this purpose, the Network proposes the "Low Cost Collaborative Project Red Iberoamericana de Gestión y Certificación de Playas PROPLAYAS, Residuos Sólidos en Playas Turísticas - Latinoamérica (RSPT LATAM)" whose general objective was to validate a methodology for the evaluation of RSPT that represents the particularities of the coastal zones of Latin America and the Caribbean.

For this reason, the Node 49 ECUPAC of PROPLAYAS, at the Universidad Del Pacífico, joined the regional project to evaluate some of the main tourist beaches of the coastal region, as a contribution to their sustainability and at the same time to the validation of the scientific methodology proposed by PROPLAYAS. The Node contributed to the regional study with the evaluation of the SR in 18 tourist beaches of the continental coastal border of the coastal provinces of Guayas and Santa Elena, executing the evaluation in the high and low tourist seasons during the year 2019.

With the implementation of the project, UPACIFICO contributes to the fulfillment of the Sustainable Development Goals, in particular No. 8 Decent Work and Economic Growth, No. 12 Sustainable Production and Consumption and No. 14 Marine Life. (UNDP, 2016). The latter is important because, according to *Sachs et al.*,(2021) the comprehensive progress by goal for the country, are discouraging for No. 8 and No. 12, only in No. 14 there is a moderate improvement, remaining many challenges to be solved.

The general objective of the work was broken down into specific objectives:

1. Determine the distribution, sources and types of solid waste at each of the 18 study beaches in the provinces of Guayas and Santa Elena.

2. Establish the particular and regional patterns that each beach presents with respect to the generation of RSPT; and 3.

3. Implement the joint RSPT evaluation methodology, supported by collaborative work and the use of mobile devices.

### Materials and methods

The methodology proposed by Proplayas and now published by Botero & Tamayo (2021) based on the Indicator of Recreational Environmental Quality (ICAR). The first parameter that makes up the ICAR was selected, which corresponds to the monitoring of solid waste in sand; its application involves the use of a methodological sheet, sampling protocol, spreadsheet, and field format.

The parameter solid waste in sand values the objects, materials, substances and solid elements generated due to the use or consumption in domestic, industrial, commercial, institutional and service activities that, being present in the sand, generate impacts on the users of tourist beaches. The impact can modify the aesthetics of the landscape or compromise the satisfaction of recreation and rest needs. In order to evaluate the parameter under study, a degree of valuation is assigned (A-E), giving the beach a rating of excellent, good, acceptable, fair or poor (Botero & Tamayo, 2021).

For the application of the ICAR, the personnel who participated in the monitoring were trained. Each team member reviewed the monitoring protocol provided by PROPLAYAS and submitted an evaluation test to validate and measure knowledge of the method, especially the identification of each type of waste.

The beaches to be monitored were chosen based on their proximity to the headquarters of the research group at the Universidad Del Pacífico. Ten beaches were selected in the province of Guayas and 8 in the province of Santa Elena. The list of the 18 beaches where monitoring was carried out is shown in Annex 1. The location, presented in UTM 17S coordinates, corresponds to the midpoint of the resting zone, which was used for the elaboration of the location map (Figure 1).



**Figure 1** Figure 1. Study area, location of sampling beaches.

In December 2018, a pilot outing was conducted to Playas (General Villamil) to test the tools to be applied, virtual training, access to the mobile data network and corroborate the availability of the necessary materials/equipment.

Field work was carried out between February and September 2019, covering the high and low seasons of beach tourism. The data were collected by walking and observing a strip of sand 1 m wide and 100 meters long, along the beach in three pre-established areas of the beachfront called Services, Rest and Active, whose characteristics and location are shown in (Figure 2).

	ZONA DE SERVICIOS
	ZONA DE ENLACE Y ESPACIO PÚBLICO
a. a. a.	ZONA DE TRANSICIÓN
♠ ♠ ♠ ♠ ♠	ZONA DE REPOSO
R I I I I I I I	ZONA ACTIVA
	ZONA DE BAÑISTAS
	ZONA DE ACCESO PARA NAVES
	ZONA DEPORTES NÁUTICOS
	ZONA TRÁNSITO DE EMBARCACIONES

## **Figure 2** Figure 2.

Diagram of the waste observation zones according to the methodology. methodology.

As indicated in (Figure 2), the first zone "Services" is located further away from the water line and is recognized by the presence of facilities to provide services/products to visitors, the "Rest" zone is characterized by being used for rest and relaxation using tents, parasols, beach chairs, among others, and the last one "Active" is the one where tourists do recreational activities, interact with the sand and water, do sports and other activities. The recognition of each of these zones for each beach was carried out based on the distinctive elements indicated. In rural and remote beaches, there is generally no service area; in these, it was established as the area adjacent to the resting area.

The waste is classified into 13 categories and within them 4 subcategories, the latter corresponding to the subdivision of the classes Potentially Hazardous Waste and Organic Waste (See Table 1), resulting in a total of 15 categories. The wastes were identified and counted in situ during the 100-meter transect walks along each of the monitoring zones (Figure 2).

10	CATEGORÍA	70.0	CONTEO RESIDUOS SÓLIDOS EN ARENA					
0		100	A (10)	B (30)	C (90)	D (300)	E (1000)	
R1	Residuos de aguas residuales	Condones, pañales, toallas sanitarias, pelo, similares	0-24	25-49	50-69	70-99	100+	
R2	Residuos provenientes del mar	Latas, envoltorios de alimentos, botellas plásticas, pañales, similares	0-24	25-50	50-70	70-100	100+	
R3	Residuos gruesos	Partes de carros, electrodomésticos, similares	0	1-4	5-14	15-24	25+	
R4	Residuos comunes	Latas, envoltorios de alimentos, botellas plásticas, similares	0-99	100-499	500-799	800-1199	1200+	
R5	Residuos potencialmente peligrosos_1	Vidrios rotos, botellas de vidrio, similares	0	1-4	5-24	25-44	45+	
R6	Residuos potencialmente peligrosos_2	Otros: Jeringas, cuchillas, similares	0	1-9	10-19	20-29	30+	
R7	Residuos vegetales voluminosos	Troncos de madera, similares		1-49	50-99	100-199	200+	
R8	Residuos vegetales no voluminosos	Hojas, algas, musgos, similares		50-99	100-199	200-299	300+	
R9	Residuos orgánicos animales	Animales muertos, restos de pescado, similares	0	1-4	5-9	10-14	15+	
R10	Residuos orgánicos vegetales	Cáscaras de frutas, restos de alimentos, similares	0-14	15-49	50-89	90-124	125+	
R11	Poliestireno/Icopor	Neveras, vasos, láminas, boyas, similares	0-14	15-29	30-44	45-59	60+	
R12	Colillas de cigarrillo	Número	0	1-49	50-99	100-149	150+	
R13	Acumulaciones	Número	0	1-4	5-9	10-14	15+	
R14	Aceites	Apariencia	Ausente	Traza	Aceptable	Molesto	Desagradable	
R15	Heces	Número		1-4	5-9	10-14	15+	

Table	1
Table	1

able with the categories, IDs, their description and waste classification ranges according to count.

Field data were initially recorded on paper forms for each of the three zones on each beach and were subsequently consolidated using the KoBoCollect mobile application, from which they are sent to the cloud and accessible from the web to the PROPLAYAS Network coordination and to the users of each node that participated in the project.

Complementary materials such as cell phones with camera and internet access and a camera were used to record and document the monitoring on each beach and the findings, as well as a GPS application for cell phones; a 50-meter tape measure to measure the transects, field notebooks were also used to record news and data detected, which were then uploaded online to the PROPLAYAS platform. The online form for the regional project in mobile format and downloadable from the Google platform (Play Store) was accessed using the KoBoCollect application. Its interface is presented in (Figure 3 a).



Figure 3 Figure 3

a) Screen shot of the data capture screen of the KoBoCollect application b). Screenshot of the GPS Status application.

Each one of the researchers and research assistants uploaded some of the 108 forms corresponding to each of the three zones on the 18 beaches, in the two tourist seasons monitored (Table 2), using KoBoCollect.

Names of beaches/canton/province/parish	UTM coordinates midpoint, resting area		Dates of monitoring (dd/mm/yy)		Sampling time from/to		
	This	North	High	Low	High	Low	
			season	season	season	season	
Varadero/Guayaquil/Posorja.	577798	9698870	09/02/19	28/06/19	10:00/12:30	13:42/13:55	
Malecon/Playas (General Villamil).	577798	9698870	09/02/19	28/06/19	13:20/14:40	10:47/11:30	
Chipipe/Salinas/Santa Elena.	502265	9756928	16/02/19	26/07/19	11:40/12:31	11:51/12:06	
San Lorenzo/Salinas/Santa Elena	502983	9756295	16/02/19	26/07/19	10:30/11:30	11:07/11:31	
Ballenita/Santa Elena/Santa Elena/Santa	514122	9756524	08/03/19	26/07/19	10:30/10:55	13:34/13:50	
Punta Blanca/Santa Elena/Santa Elena/Santa Elena	523260	9762098	08/03/19	09/08/19	11:30/11:55	11:05/11:22	
San Pablo/Santa Elena/Santa Elena/Santa Elena	525137	9763740	08/03/19	09/08/19	12:20/12:40	10:20/10:32	
Rosada/Santa Elena/Santa Elena/Santa	527873	9778102	16/03/19	23/08/19	10:51/11:31	11:15/11:34	
Montañita/Santa Elena/Santa Elena/Santa Elena	527355	9798100	16/03/19	23/08/19	12:50/13:13	12:24/12:39	
Olón/Santa Elena/Santa Elena/Santa	526721	9801190	16/03/19	23/08/19	13:51/14:30	13:00/13:14	
Chabelita/Playas/Guayas	56666	9708301	29/03/19	28/06/19	10:20/10:45	12:00/12:16	
Puerto Engabao/Playas/Guayas	554755	9716943	29/03/19	09/08/19	12:30/12:50	13:20/13:32	
Paraíso Engabao/Playas/Guayas	556665	9714880	29/03/19	09/08/19	13:20/13:30	13:51/14:05	
Paseo Shopping/Playas/Guayas	568040	9707793	29/03/19	28/06/19	11:17/11:41	12:40/13:10	
Bellavista/Puna/Guayas	586222	9693293	12/04/19	20/09/19	11:24/11:28	14:00/14:20	
Cauchiche/Puna/Guayas	584534	9691194	12/04/19	20/09/19	11:51/12:10	13:30/13:45	
High/Puna/Guayas Climb	583113	9687149	12/04/19	20/09/19	12:40/12:47	12:07/12:30	
Las Palmeras (Arenal)/Puna/Guayas	583957	9689195	12/04/19	20/09/19	13:10/13:17	12:55/13:08	

#### Table 2 Table 2

#### List of the 18 beaches monitored

Another application downloaded from the Play Store to the cell phones was a GPS (Figure 3 b.) that allowed the location of the monitoring zone points on each beach to ensure accurate positioning of the same zones in subsequent monitoring.

## Results

The first analysis is directed to the assignment of the valuation (A, B, C, D, E), according to the residue count for each category (Table 3). In the cases of R3, R5, R6, R7, R9, R12, R13, R14 and R15 the highest valuation "A" is assigned only if the count is zero or there is no presence, this is related to the nature of these types of SR that are perceived as having a greater impact either by their size, the impact they have on the landscape, the environment or the risk to people's health. Common waste being the most expected and non-bulky vegetables perceived as having less impact, have larger and more tolerant ranges in their categories.

In reference to the aspect raised in the previous paragraph and to those specific types of waste, they presented in total 2 times "E" values and 11 times "D" and "C" values. If the occurrences consider occurrences other than "A" as deviations from a desired value, overall this occurs 10.7 % of the time. The percentage distribution for sources and types of waste at each beach is reported. It also establishes the particular and regional patterns of beaches with respect to the generation of RSPT. In 14 of the 18 beaches, the main source of waste is tourist activity and a very small percentage corresponds to waste from the sea, especially remains of green string used for mooring boats, especially small-scale fishing boats; this type of string is also used in the mooring of hammocks and tents in the kiosks of the service and rest areas. All beaches have receptacles for users to deposit their waste, which are collected by beach service providers. The fact that waste is still found on the sand is evidence of a lack of care and environmental education on the part of beach users.

The four remote tourist beaches of Puná Island are a separate case, where the general pattern of waste distribution is possibly due to external factors. possibly corresponds to external factors.

Common wastes (R4) are the most frequent, being present in 100% of the beaches, always with an "A" rating. .

The aggregate results or frequencies by valuation grade for each monitored beach are summarized in Table 3, in which the beaches of Santa Elena province are differentiated by appearing in colored cells. The type of waste is also included for categories C, D and E only.

Table 3
Table 3

NAME BEACH	Α	в	С	D	Е
Ballenita			1 (R8)		
Bellavista (Puná)				1 (R13)	
				1 (R9)	
Cauchiche (Puná)			1 (R15)	2 (R13)	1 (R14)
			1 (R9)	1 (R9)	
Chabelita-Playas			1 (R13)		
Chipipe (Salinas)					
Malecon-Playas					
Montañita		5	1 (R12)		
			1 (R15)		
Olon	86				
Paseo Shopping-Playas	82				
Paraíso-Engabao Beach			1 (R9)		
Rosada Beach	82				
Puerto Engabao			1 (R13)	1 (R11)	
Punta Blanca			1 (R8)		
San Lorenzo (Salinas)					
San Pablo					
Subida Alta (Puná)			1 (R15)	1 (R15)	1 (R15)
				3 (R13)	
Las Palmeras-El Arenal (Puná)			1 (R15)	1 (R14)	
Varadero	86				

Frequency of occurrence by category and type of waste at each beach, in parentheses is the type of waste with the ID presented in Table 1.

Regarding the source of the SW, understood as the determination of whether they come from activities on the beach itself, from nearby urban centers or from the continent in general, or whether they arrive from the sea, this is not within the scope of the methodology; however, one of the categories allows inferring from all the data those wastes that are attributable to dragging towards the beaches from the sea, whether by currents, waves or tides; This is the category of waste from the sea (R2), which in our study included mainly the remains of fishing gear and ship's gear (ropes and ropes of various diameters).

For the analysis by beach zone, Activa had the best results in the 18 beaches, while the other two zones had different results in Guayas and Santa Elena.

Figure 4 shows with bars the results obtained in the monitoring by season, by type of waste and by province. R1 and R2 do not appear in (Figure 4a) because they always had an A grade, analogous case for R1 to R4 in 4b).



### Figure 4 Figure 4

Frequency of waste types by province and by typology. a) Beaches in the province of Guayas b) Beaches in the province of Santa Elena.

#### Guayas

Some of the beaches had "D" and "E" values. Subida Alta, 4. Subida Alta El Arenal and 5. Puerto Engabao for the types: Organics (1 and 2), Polystyrene (5), Accumulations (1, 2, 3), Oils (4) and Feces (3), both in high and low season. The "E" rating was presented only in 3. Subida Alta and 2. Cauchiche, for: Stools (3.), Oils (2.), in low season.

The least frequent waste was coarse debris, which only appeared at Bellavista beach on Puná Island (10%); and potentially hazardous waste (broken glass, glass bottles, etc.) found at Cauchiche (10%), oils were not detected at any of the 10 beaches studied during the high season.

For the 6 beaches located in the cantons of Playas and Guayaquil, the RSPT are mainly of local origin, product of tourist activity, while for the 4 beaches of Puná Island, parish of Guayaquil canton, they are probably of external origin, possibly coming from the city of Guayaquil and carried to the island by the Guayas River and the tides of the estuary.

The exercise of rating the beaches according to the valuation achieved considering the numerical weighting for each level of the count (A:10, B:30, C:90, D: 300 and E:1000 according to the methodology being validated) by type of waste as shown in (Figure 4), resulted in two beaches with a higher sum equivalent to a greater presence of waste and therefore lower quality of the

beaches, these are Subida Alta and Cauchiche, both on Puná Island and the best rated in this group was Varadero, belonging to the Posorja canton.

In this group of beaches, "D" and "E" grades were given for the areas of Servicios y Reposo, Puná Island and Puerto Engabao.

The following photographs show images of some of the various types of debris that were found during the monitoring campaigns (Photo. 1).



Photo 1 Photo 1. Main sources of waste present on the beaches.

St. Helena

These beaches only had values in categories from "A" to "C". The distribution of waste by category for cigarette butts (R12) is distinctive for Montañita, where 48% corresponds to "B" and 50% is "A".

The least frequent wastes were Coarse and Oils, which were not detected in any of the eight beaches studied, Accumulations and Bulky Vegetables (1) time,

Polystyrene/Icopor, Hazardous vegetable organics such as syringes and similar (2) times.

The exercise of rating the beaches according to the valuation achieved considering the numerical weighting for each level of the waste count resulted in very similar values for the eight beaches, Ballenita has the highest sum but not very different from the other beaches, which means that it presented a greater presence of waste and therefore its beaches have lower quality, the best rated in this group was Olón.

In the analysis by zones of these beaches, the Services beach was the one that presented the worst grade, although in no case was this grade higher than "C".

For the beaches located in the cantons of Santa Elena, the RSPT are mainly of local origin, as a result of tourism activities. Other results of the project were the rapprochement with the community of Puná Island and Playas Villamil, for possible cooperation links of mutual benefit.

In the results of Mestanza *et al.*, (2019). the beaches of Santa Elena are among those with the highest presence of waste, however in that study the beaches of Guayas were not included; in this work in which only beaches of Santa Elena and Guayas are considered, those of the latter are the ones that presented the lowest quality in terms of the RS factor.

The influence of the tourist seasons on SR on the beaches is evidenced by the higher frequency of "A" found for all types of waste in the low season and the opposite behavior for categories B - E which have lower frequency for that same season, this behavior is consistent for the beaches in the two provinces. As in the previous cases, the values for Puná partially distort this trend. In September 2019 there were serious protests from the communities of Puná Island, widely documented by the national media for the excess of RS on their beaches attributed by them to the dredging of the access channel to the deep water port of Posorja.

Likewise, the SR data for Puná Island in the low tourist season are contrary to the general trend of decreasing and are probably attributed to the phenomenon described above, since the monitoring was carried out precisely in that month.

However, from a review of the less desirable values such as "E" and "D" it was observed that they occurred mainly on the Puná beaches and that they skewed the overall results of the Guayas beaches. biased the overall results of the Guayas beaches.

According to the geographic location of the beaches of Guayas and Santa Elena in proximity to the mouth of the Guayas River, the influence of the latter cannot be ruled out as a factor related to the transport of SR to them, as evidenced by the values obtained in the four beaches of Puná Island.

A continuation of the results of the project would be a proposal for a permanent waste monitoring program, in order to provide management tools to the GADs in their task of carrying out the Sea Beach Management Plans mandated by the 2017 Organic Environmental Code.(Organic Environmental Code). This program could even involve the measurement of new parameters of the environmental quality index of beaches that could contribute to a possible certification of these.

In a continuation of the study, it will be of interest to include oceanographic variables and a method to infer their contribution to the presence and type of debris on the coasts.

# Conclusions

ECUPAC node 49 contributed to the validation of the PROPLAYAS regional methodology for measuring solid waste on tourist beaches, generating contributions to the methodology based on field trips.

The results show that the beaches monitored have solid waste of various types, with common waste being the most frequent. Also during the high season from January to May, there is a higher incidence of solid waste. It is considered that the quality of the beaches studied in terms of this parameter of environmental quality of tourist beaches is good, with the exception of Puná Island.

The RS are higher in high season, which corroborates the correlation between the number of tourists versus the presence of solid waste.

The results are the basis for a permanent monitoring program of solid waste on tourist beaches with a view to their international certification, with regional and global endorsement through the PROPLAYAS Network. In this sense, it is planned that the project will become a permanent monitoring program, not only for solid waste on the 18 tourist beaches, but also for six other parameters of environmental quality of beaches, such as 1. If the project is converted into a permanent program for monitoring the environmental quality of tourist beaches, its academic, social and economic impact will be much greater.

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