

# Revising the limits of the coastal area in the regulations of the iberoamerican region. Are they appropriate for risk management and adaptation to climate change?

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## ABSTRACT

Coastal laws define the boundaries of the coastal zone. Both a terrestrial part and a marine part are usually included, which can be anything from ten to two hundred or more meters. They are usually declared public domain zones, and a protection zone, parallel to the coastal edge, is often determined. The function of the protection zone is to reduce pressures of anthropogenic origin on coastal ecosystems, its services and, simultaneously, mitigate extreme natural phenomena within the inhabited areas of the coast. Protection zones are established according to different types of criteria. In this study, they have been classified into two main groups: scientific/universal criteria and functional/operational criteria.

Integrated coastal zone management addresses complex problems for the organization of economic uses and activities, based on the protection of ecosystems, while addressing coastal risks. At present, erosion is one of the most serious issues affecting the coast, a problem that is likely to intensify as a result of sea level rise, which is an effect of climate change. The objective of this paper is to analyze regulations affecting the coast in the Ibero-American Region, paying special attention to the definition of the geographical area. Results of this study are: most laws, especially in the terrestrial area, use arbitrary criteria and metric distances. In the marine environment, the limit of the coastal zone is usually fixed up to 12 nautical miles from the Territorial Sea. On few occasions, natural-physical criteria are used, which take into account the characteristics of the coast and anthropic criteria, such as the socio-economic reality. This means that limits have been established that are politically functional, as well as practices that do not take into account the vulnerability of the area, the functioning of coastal ecosystems or protection against natural risks. We are in no doubt that, faced with the challenge of establishing adaptation measures for the effects of climate change, the search for a new delimitation of the coastal zone should be considered an urgent matter.

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## 1. Introduction

Without doubt, the characteristics of coastal areas have facilitated the concentration of numerous economic activities (tourism, maritime transport, ports, fishing, aquaculture, agriculture and industry). The population in the area has grown and, consequently, its impact will continue to increase (World Resources Institute, 2010). According to Barragán and de Andrés (2015), in a study of coastal cities and agglomerations, 40% of the world's population live on the coast; therefore, there is a significant human concentration in a small area, i.e. between 4% and 15% of the total surface of the Earth. The estimated world population is 7700 million people in 2019 (UN-ESC, 2019).

In any case, the future is uncertain, with a high probability of disaster risk. The erosion induced by climate change is one of the most serious risks facing the coastal systems of the planet. Coastal storms can cause significant damage to the coast. This is a complex issue, as the resistance of the coastline to changes in the physical environment varies spatially and temporally in response to factors such as changes to the volume of beaches, the reduction of sediment supply and the degradation of coastal wetlands. We must also consider human interventions that are socio-economically, politically and culturally determined (Brown et al., 2018; Toimil et al., 2017). Consequently, emergency actions have been taken on a regular basis to mitigate damage, using structures which were originally meant to be temporary, to

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protect the coastal edge. Over time, many of these structures have become permanent (Neal et al., 2018). Paradoxically, these measures corresponded to public policies with short-term vision.

These risks are normally confined to narrow areas adjacent to the coast. Additionally, erosion can trigger catastrophic flood events if natural barriers, such as dunes, are broken. Long-term erosion, which is occurring widely along the world's coasts, can cause the loss of land and certain beach ecosystem services, that are exploited by tourism (Klein et al., 2003). So far, decision-making for the management of coastal erosion has been strongly conditioned by economic considerations. However, adaptive actions, other than protective measures, such as hard engineering and permanent structures that are used to protect property and economic activities (jetties, breakwaters and dikes) are beginning to be considered. Although there are only few examples, it is being suggested that where protection infrastructure is necessary, buildings must be removed (Williams et al., 2018, Martínez et al., 2017). In this regard, the coastal fiscal vulnerability index proposed by Kantamaneni (2016) is of interest. In these cases, with coastal settlements continuously growing, there is no doubt that a greater number of protection measures will be necessary.

According to the IPCC report (2014), the average level of the sea will continue to rise globally during the 21st century. Although, sea level rise will not be uniform from one region to the next, coasts will be exposed to greater risks, particularly to erosion, due to climate change as well as rising sea levels. This effect will be exacerbated by the increasing pressure exerted by human presence on the coastal areas and their ecosystem services. It is very likely that by the end of the century, the sea level will have increased in approximately more than 95% of the areas occupied by oceans. In the 21st century, as climate change has intensified, extreme weather events (hurricanes, cyclones and typhoons) have increased in an unprecedented manner, producing some of the most dramatic coastal flooding of recent years. Therefore, in Ibero-America there has been a substantial increase in the implementation of sectoral and territorial initiatives to adapt to climate change (CAF, 2013), with all countries in the region having adopted a national strategy to adapt to climate change (Sánchez and Reyes, 2015) (See Table 1).

The definition of the coastal zone is one of the first necessary steps before a strategic plan can be developed (Crean, 2000). Over time, the geographical scope and its limits have been established imprecisely, using very different criteria. Thus, in carrying out an analysis of progress in integrated management of coastal zones since the 1990s, evolution in the delimitation of the coastal zone has been observed and boundaries extended (Pérez-Cayeiro, 2013). In any case, experience demonstrates that regulations do not always take into account physical

Table 1  
Initiatives for adaptation to climate change in Ibero-America.  
Source: Adapted from Sánchez and Reyes, 2015.

Brazil	National Climate Change Adaptation Plan (2016)
Chile	National Climate Change Adaptation Plan 2017-2022 (2017)
Colombia	National Climate Change Adaptation Plan (2012)
Costa Rica	National Climate Change Strategy (2009)
Cuba	Action Plan of the National Climate Change Strategy (2011)
Ecuador	Proposal for a Program to Combat Climate Change (2015)
El Salvador	National Climate Change Strategy of Ecuador 2012-2025 (2012)
Guatemala	National Climate Change Strategy (2013)
	National Action Plan on Climate Change (2016)
	Adaptation Plan to Climate Change in the Pacific of Guatemala (2018)
Mexico	National Climate Change Strategy. Vision 10-20-40 (2013)
Peru	National Strategy against Climate Change (First draft 2014)
Portugal	National Strategy for Adaptation to Climate Change (2015)
Spain	National Climate Change Adaptation Plan (2006)
	Adaptation strategy to the climate change of the Spanish coast (2016)
Venezuela	First National Communication on Climate Change of Venezuela (2005)

vulnerability when defining the scope of management. This is because some laws do not consider different environmental characteristics of coastal areas (Sas et al., 2010), despite the fact that, in the 21st century, recommendations made by international organizations have moved in this direction.

Following the hypothesis of Milanés et al. (2019), anthropogenic activities and their impact on the coast should also be considered as key criteria for setting the limits of coastal and marine area subjected to legislation. However, establishing a definition of the coastal and marine zone in line with the management of coastal risks, and adaptation to climate change, is of greater importance and has become an ambitious challenge.

In the current context, decision makers are challenged with finding the best way to adapt to the effects of climate change. Regulation is a very valuable instrument that may well provide protection to coastal ecosystems, populations and the goods and services that guarantee human wellbeing. It could well represent a change of strategy for the management of the world's coasts.

We have reviewed what type of criteria have been most commonly used to determine geographical scope. Table 2 synthesizes and classifies them into two large groups. On the one hand, those that are formulated from a scientific and academic perspective and are therefore more universal. And on the other hand, the criteria that have been proposed with a functional and operational perspective - i.e. they have been designed for specific cases. This second classification is considered more practical and easy to apply for several reasons, one reason being the convenience of adopting criteria that, in some ways, allows for a degree of flexibility. Another argument being that these limits reduce the scale of work, thus facilitating management tasks (Pérez-Cayeiro, 2013).

## 2. Objectives, hypotheses and methodology

The aim of this research is to carry out a critical analysis of the legislative instruments that affect the littoral of the Ibero-American Region, paying special attention to the definition of the geographical scope in the relevant legislation. There are several reasons justifying the choice of this region as a field of study. Firstly, the normative model of the majority of the Ibero-American States are heirs to Roman Law. Secondly, the shared cultural identity that can broadly be considered homogeneous and of common historical heritage, marked by colonial influence, mainly from Spain and Portugal, is part of the identity of Latin American countries. The highest expression of this is the use of common language, generalized as Spanish and Portuguese (Scherer et al., 2014). Thirdly, in these nations a great diversity of coastal-marine ecosystems and very different socio-economic realities are represented. Fourthly, more than half of the total population lives in the coastal zone and, consequently, many of the large urban centers and regions are located there (Barragán, 2012). And finally, similar pressures and threats are identified in relation to the stability and vulnerability of their coasts and to the effects of climate change.

The analysis is based on a previous hypothesis that is expressed, schematically, as follows: The limits and definitions of the geographical area must be established in law to guarantee its legitimacy. In most cases, these limits have been set using a criterion of arbitrary measures in both terrestrial and marine environments. The regulations do not usually use scientific or universal criteria. Therefore, it can be inferred that the laws are not designed to deal with the risks to which the coastline is exposed and, much less, the effects of climate change.

The study of the definition of the coastal zone in the Ibero-American Region calls for a comparative analysis of the specific coastal management laws and, failing that, the national or regional constitutions or civil codes. The methodological program is described in the five following steps:

1. The preliminary analysis of the normative instruments applicable to the area of study.

Table 2  
Criteria used to delimitate the coastal zone.

	Criteria	Source
Scientists/Universal	<ol style="list-style-type: none"> <li>1. Geomorphological units and/or physical variables (e.g. bathymetry) and/or permanent physical elements (e.g. road).</li> <li>2. Earth-Sea interface, has two main axes. One runs parallel to the shore of the sea, while the other runs perpendicular to the shore.</li> <li>3. Bipartite scheme: biophysical-socioeconomic aspects.</li> <li>4. Tripartite scheme: physical, social-economic, legal aspects.</li> <li>5. Three environments: watersheds; coastal zone and marine environment.</li> <li>6. Current conditions of the area and future conditions (scenarios).</li> <li>7. Large Marine Ecosystems "area of focus".</li> <li>8. Primary Environmental Coastal Unit.</li> </ol>	<p>Salomons et al. (1999), Legault and Hanley (1993), Clark (1992)</p> <p>UNEP (1995), OCDE (1995), Beatley et al. (1994), Sorensen (1990), Ketchum (1972)</p> <p>Brenner et al. (2006), European Commission (2002)</p> <p>Barragán (2014), Chica (2008)</p> <p>Pallero et al. (2017), Molle (2009), UN (2005), UNEP/MAP/PAP (1999), Sorensen (1993)</p> <p>IOC-UNESCO (2009)</p> <p>Domínguez- Tejo et al. (2016), Olsen et al. (1999)</p> <p>Milanés et al. (2017)</p>
Functional/Operative	<ol style="list-style-type: none"> <li>9. Integrated Management: structural, functional, social economic and ecosystem bases that interact as a whole.</li> <li>10. Problem object of the management.</li> <li>11. Indicators = Force-Pressure-State-Impact and Response (DPSIR).</li> <li>12. Legal and administrative aspects</li> <li>13. Arbitrary measures that are often based on jurisdictional terms or defined for reasons of administrative convenience.</li> </ol>	<p>Balaguer et al. (2008), Kay and Alder (1999), Clark (1996), Ochoa (1995), UNEP (1997), IOC-UNESCO, 1997</p> <p>Tanaka (2004), Baja et al. (2002)</p> <p>Lewinson et al. (2016), CBD (2004)</p> <p>Sas et al. (2010), Portman (2006), European Commission (1999), FAO (1998), World Bank (1996), Hildebrand and Norrena (1992)</p> <p>Vállega (1999), OCDE (1995)</p>

2. The selection of countries that have a specific law for the coastal zone that explicitly defines and delimits its coastline.
3. The systematic review of published studies dealing with the definition of the coastal zone at different levels (international, regional and national). From these studies, information was extracted to identify which elements and factors are relevant for the development of coastal management regulations.
4. The identification and description of the key elements for the comparative analysis. In addition to the definition and description of limits, the criteria used to determine the geographical area (geomorphological, arbitrary, metric, functional and operational), the existence or absence of protection zones, and how to measure their limits were also considered to be of interest.
5. From the elements previously identified, a comparative analysis is carried out and a series of conclusions and recommendations are drawn, having the potential to be considered in a future coastal management law.

The sources of information used for this research have been of diverse nature. Bibliographic and documentary information has formed the basic pillar of the first part of the study, while the second part has been compiled from the analysis of legislative instruments in each country.

### 3. Results and discussion

Thirteen Ibero-American countries have been selected that have specific regulations for coastal management and/or their resources. Table 3 shows the most relevant information: geographical scope, limits and criteria. The criteria used to delimit the coastal zone are scientists/universal (S/U) or functional/operative (F/O). Numbers from one to 13 indicate the specific criteria employed (see Table 2).

In Central America (Table 3) it can be seen that, in most laws, only the terrestrial strip is defined. This is the case in Costa Rica, Guatemala and Mexico. Conversely, the Constitution of El Salvador (1983) does actually establish the limits for the marine part in accordance with criteria of the United Nations Convention on the Law of the Sea (UNCLOS, 1982). Cuban legislation applies a geomorphological criterion depending on the extent of the insular platform or depth (between 100 m and 200 m). However, the implementation of the law of Cuba has been difficult in most coastal municipalities, due to the lack of information regarding specific characteristics of the types of coasts (Milanés et al., 2019; Milanés, 2018 and Milanés and Pérez, 2012). According to these authors, there are certain criteria of interest that

have not been considered by the legislation. The criteria include marine dynamics and how they affect land changes that occur in geomorphological units as a result of anthropogenic activities. Therefore, these aspects will not be used in the prevention of coastal natural risks within the region.

In fact, it has been observed that within regulations in Central America, arbitrary measures are used to establish the area of public domain and, in some cases, the protection area. That is, conventional and/or agreed lengths are established. In essence, the term arbitrary refers to a spatial demarcation for management that does not consider physical elements (neither environmental, nor anthropogenic) and, therefore, does not aid ecosystem conservation efforts, or their integration (Sas et al., 2010).

A physical criterion is only used in terrestrial limits (the limit of the Highest Maximum Spring Tide), as a reference point to establish the arbitrary measures of the public zone. This occurs in the laws of Costa Rica, Guatemala and Mexico. In Cuba the limits of the "Coastal Zone" are measured towards land, taking into account the existence of coastal vegetation. Conversely, in El Salvador the coastline is taken as a reference, but without specifying its significance, which is even more imprecise.

It is also normal to establish a buffer zone and protection in the stretch of land parallel to the coastal zone, where there is usually a restriction of uses or activities (e.g. Costa Rica and Cuba). Although this strip has different extension measures depending on the particular case, the existence of this protection zone, and its extension limits, is fundamental to preserve certain coastal ecosystems, especially the most vulnerable ones, such as wetlands, dunes, beaches and coastal lagoons. In Costa Rica, it is called The Restricted Zone, and measures 150 m, with the function of defending the public zone. For this reason, legal authorization is required to do any of the following: exploit flora and fauna, divide land with fences or lanes, construct buildings or facilities, cut trees, extract resources or carry out any other type of development, activity or occupation. However, in countries with growing demand for tourism, the existence of this strip could safeguard the natural heritage of the coast. Nonetheless, more effective management as well as the integrity of the ecosystem would be guaranteed if basic parameters of beach functioning were employed, such as coastal geomorphology, hydrodynamics, sand granulometry, deposits in estuaries and coastal drift (Morales et al., 2009), which would be more beneficial than criteria of fixed distances.

We must differentiate the case of Guatemala from the rest of the Central American regulations. Decree (126/97) defines the "territorial reserve areas of the State" that are not to be considered for public use.

Table 3  
Geographical scope and limits of the coastal zone of the Ibero-American Region.

Country/regulations	Geographical scope		Limits	Criteria
Brazil Law 7661, Coastal Management, 1988. Decree 5300/2004, which regulates the Coastal Management Law (7661/88). Resolution CIRM 5, 1997 and Law 9.760, National Heritage, 1946.	Coastal zone: Geographical space of interaction between sea and land, including its environmental resources. Marine lands	Maritime strip Land strip	12 nautical miles from the straight baselines and the Territorial Sea The municipalities that are on the coastal edge 33 m measured horizontally towards land from the average high water line in 1831	F/O 12 F/O (11) F/O (10)
Chile Supreme Decree 475, National Policy of Use of the Coastal Edge, 1994.	Coastal edge: fringe of the territory that includes the fiscal beach lands, the beach, the bays, gulfs, narrows and inner channels and the territorial sea of the Republic.	National resource for public use Protection Zone	The general limit is up to the high tide line: beach, bays, gulfs, narrow and inland channels, and the territorial sea (12 nautical miles). a) In front of fiscal (public) properties, it corresponds to a strip of 80 m wide, measured from the high tide line. b) In front of private property (there is no protection zone)	S/U (1) and F/O (12) F/O (13)
Colombia Decree 1120 of 2013, coastal and ocean environmental units	Continental Coastal Zone	Marine-coastal subzone, or offshore strip. Subzone of low tide or transition strip Terrestrial-coastal subzone or strip of inland	Between the Low Average Tide Line (LATL) and the external margin of the continental shelf. Conventionally this edge is in the 200 m isobath. Between the Low Average Tide Line (LATL) and the High Average Tide Line (HATL). From the High Average Tide Line (HATL) to a parallel line located 2 km away inland.	S/U (1) S/U (2) S/U (2)
Costa Rica Law 6043, Maritime-Terrestrial Zone, 1977.	Insular Coastal Zone Maritime Terrestrial Zone: 200 m width on the Atlantic and Pacific littoral, whatever its nature, measured horizontally from the line of the ordinary high tide and the lands and rocks that are exposed at low tide.	Public Zone Restricted area	50 m measured from the ordinary high tide and the following areas: islets, boulders and natural formations that protrude at low tide. 150 m remaining land up to 200 m	F/O (13) F/O (13)
Cuba Law 2, Management of the coastal zone, 2000.	Coastal Zone (CZ): maritime-terrestrial strip, of variable width, with interaction of land, sea and atmosphere, through natural processes. In it, exclusive forms of fragile ecosystems are developed and particular economic, social and cultural relations are evident. Protection Zone: bordering the coastal zone that cushions the negative effects of anthropic actions.		1. CZ limits towards land measured from the beginning of the strip of consolidated natural vegetation closest to the sea: a) 20 m on a low terrace or cliff-side coast. b) 40 m on the beach or low mangrove coast: c) River mouths: limit of 300 m in a straight line to land, starting from the mouth, following the longitudinal section of the river and 60 m inland on both banks, until the effect of the tides arrives. 2. CZ limits towards the sea will be the edge of the insular platform of the territory, regularly at depths between 100 and 200 m.	S/U (1) F/O (13)
Ecuador Ecuadorian Civil Code, 46, 2005.	Maritime Terrestrial Zone: the adjacent sea and its beaches are called national resources for public use or public resources.		The intertidal zone extends, until the lands covered by the maximum tides.	S/U (2)
El Salvador Decree 38, Constitution of the Republic of El Salvador, 1983.	Marine coastal zone: continental part, the sea, the subsoil and the seabed.		a) Terrestrial strip: 20 km from the coastline. b) marine strip: from 0 to 100 m depth, the seabed up to 200 nautical miles from the low-water mark and where the species of sea-floor organisms are distributed.	F/O (13)
Guatemala Decree 126, Law regulating the areas of territorial reserves of the state, 1997.	Territorial reserve areas of the State: areas contained in the land strip parallel to the oceans.		a) 3 km from the high tide line. b) 200 m around the shores of the lakes. c) 100 m on both sides of the banks of navigable rivers. d) 50 m around the springs and fountains.	F/O (13)
Mexico General Law of National Assets, 2013.	Federal Maritime Terrestrial Zone (ZOFEMAT): areas adjacent to the beaches and passable parts; lakes, lagoons, estuaries or natural deposits of seawater that communicate directly or indirectly with the sea.		a) on beaches: 20 m counted from the high tide limit. b) in cliffs: 20 m adjacent to the marine littoral, in areas that in a horizontal plane have an angle of inclination of 30° or less.	F/O (13)
Peru Law No. 26,856, the beaches of the coast are public property, 1997.	Beach: an area where the coast appears as a bare flat with a gentle slope towards the sea and formed by sand or stone, boulder or sand interspersed with mud. Restricted domain zone		Strip not less than 50 m wide parallel to the high tide line. A 200 m strip located after the 50 m strip, provided there is geographical continuity.	F/O (13) F/O (13)

(continued on next page)

Table 3 (continued)

Country/regulations	Geographical scope	Limits	Criteria
Portugal Law 468, maritime public domain regime, 1971. Law 16/2003.	Maritime Public Domain (MPD) a) Coastal and territorial waters b) Inland waters subject to influence from seas, rivers, lakes and lagoons. c) The bed of coastal and territorial waters and inland waters subject to the influence of seas. d) The seabed adjacent to the continental shelf, embracing the EEZ. e) The margins of coastal waters and inland waters subject to the influence of the seas. Adjacent zone is the area adjacent to the MPD border threatened by the sea or by floods. Adjacent areas remain on private property that are subject to public service restrictions.	50 m from the line of maximum spring high tide.	F/O (13)
Spain Law Two, of protection and sustainable use of the coast and of modification of Law 22/1988, of Coasts, 2013.	Maritime Terrestrial Public Domain (MTPD): maritime-terrestrial zone, beaches, inland waters, territorial sea and natural resources of the economic zone and the continental shelf. Protection Easement Zone of the MTPD: a strip of privately owned land adjacent to the MTPD, which is subject to certain limitations in order to protect the MTPD.	It is measured from the MPD limit to a conventional line, defined for each case, and corresponds to the maximum flood line, with a return period of 100 years, or within a range of 100 m, when the limit is not known within an entire period. The length varies depending on the interior limit of the shore of the sea. And the existence of materials of marine origin. a) 100 m in Non-Developable land before 1988. b) 20 m in Urban and Developable land.	S/U (2) or F/O (13)
Venezuela Decree 1.468 with force of law of coastal zones, 2001.	Coastal zone: geographical unit of variable width, formed by a terrestrial strip, the adjacent aquatic space and its resources; in which diverse ecosystems, processes and uses in the continental and insular space are interrelated.	a) Terrestrial strip: 500 m from the vertical projection of the highest tide line.	F/O (13)

Guatemala is not like most other countries in that the government also has the sovereign power to determine uses and occupation. In this country, the scope of control extends up to 3 km towards the continent, unlike most other states where the coastal area is not defined to more than a hundred meters. Nonetheless, there is a notable disadvantage regarding the protection of the coast, i.e. reserves are used mainly for the construction of hotels and the development of private residences or beach houses (González-Bernat and Clifton, 2017). This approach cancels out any protection of the environment and has only intensified the continuous degradation of marine and coastal ecosystems, as well as the risks of climate change.

In other countries the marine strip is included. In Brazil and Chile, the marine zone is defined by referring to the 12 nautical miles of the Territorial Sea. In Colombia, the extension of the continental shelf is taken into consideration and the marine strip is set up to 12 nautical miles offshore, except in cases where the platform is extremely narrow. In Venezuela, an approximate limit of three nautical miles has been established and it has been specified that it will never be lower.

In relation to the criteria used to delimit the management area, different types are observed. Above all, arbitrary measures are applied, and the high tide line is still set as a reference point. Chile and Ecuador consider other more scientific aspects that define the coastal zone according to the geomorphological units from which it is formed: beaches, bays, gulfs, straits or inland channels. In the Continental Coastal Zone of Colombia, three sub-zones are differentiated and when defining the terrestrial part (Terrestrial-coastal subzone or strip of inland) a strip of 2 km is determined, measured from the high tide line. However, the regulation considers exceptions to this arbitrary distance. Exceptionally, it is established from criteria such as: from the outer edge of the mangrove ecosystems and the transition forest in the Pacific; the maximum level of flooding of coastal lagoons that do not have associated mangrove forests; the areas declared as protected or the urban perimeter of the coastal population centers. This difference in establishing the terrestrial limit is undoubtedly more convenient than other types of criteria. Taking into account that normally the objective of the law is explicitly the protection of the most vulnerable ecosystems and the security of people and assets against natural coastal risks. It should be noted that all statements of motives of legal instruments that we analyzed demonstrate that the end goal of coastal management is public use, the protection of ecosystems and sustainable development. Consequently, the scale of the geographical scope is fundamental, although functional and operational criteria are also used and administrative aspects are taken into account. Therefore, and exclusively in Brazilian regulations, in the definition of the terrestrial band, the limit of municipalities that have a coastal edge has been employed.

Chile and Brazil have a well defined area of protection. In both cases, arbitrary measures are used. It is worth commenting on the Brazilian case, where the protection zones are called Marine Terrains. Dating from the 17th century, it originated in Rio de Janeiro in the colonial era. These spaces belong to the Federal Union and were defined in order to protect the coast from attacks from other nations and pirates, as well as to facilitate salt extraction, boarding and disembarking and generating income. This fact confirms that, for centuries, the vision of the coast has not changed. On the one hand, it is a frontier location that requires special protection and, on the other hand, it is an essential space as a source of resources. In Chile, the central coasts are increasingly affected by human activity. For this reason, even the 80 m covered by the protection strip on public lands (in private lots there is no protection strip) is insufficient. According to Martínez et al. (2018) between 2004 and 2016 erosion rates increased due to the sea level rising up to 30 cm. This observation was made during the warm phases of the equatorial Pacific weather pattern called El Niño-Southern Oscillation (ENSO). There has also been an increase in the frequency of extreme storms, which went from almost five events per year in the 1960s to more than 20 in recent years. The erosive tendency found in the last decade suggests that this coast could deteriorate if such factors prevail

or intensify.

Furthermore, it is surprising that the General Law of National Assets of Mexico (2013), being a relatively recent regulation, has not established a specific protection zone. In addition, the zone which is free from occupation and considered to be in the public domain, only extends to 20 m. According to Ramos (2017), this legislation does not reflect the biological and geographical reality and raises a concern about significant legal gaps. For example, there is no definition of coastal environments: maritime beaches, land reclaimed from the sea, rock formations or cliffs. However, the coastal ecosystems of Mexico are naturally exposed to recurrent disturbances that act as drivers of ecosystem dynamics. Also, in recent years, human impact has exerted intense pressures, causing alterations and, therefore, lower capacity for recovery. Meanwhile, erosion is becoming an increasingly critical problem for society and coastal ecosystem functioning (Martínez et al., 2017). With this situation, which puts at risk the quality of life of people living near coasts, the responsibility of the administration for these resources becomes even more important, as the economic and environmental future of the country depends on these resources (Ramos, 2017).

In other cases, no specific decree or coastal law exists and the regime of ownership and use is set out in a constitution, civil code or similar. In 2008, Ecuador repealed the Executive Decree that provided for the development of a Coastal Resources Management Program (Decree 375 of 1989). Different drafts of integrated coastal zone management policies that insisted on the formulation of a coastal law have been drawn up. However, as Pazmiño et al. (2018) state, to date, it is impossible to find a valid legal document that defines or provides criteria to outline coastal areas.

In Peru, the law (No. 26,856) defines an area of public domain but only in areas where there are beaches. In these cases, a protection strip of not less than 50 m in width is fixed. In addition, its second article establishes the restricted domain area as the 200 m strip located behind the 50 m strip described in the previous article, provided that there is geographical continuity in that entire area. However, Barragán and Lazo, 2018 consider the Legislative Decree 1147 (2012) that regulates the powers of the National Maritime Authority to be of interest. This decree determines the scope of surveillance and control of the state in the aquatic environment including maritime and continental waters, rivers, navigable lakes and insular areas. It also includes coastal land up to 50 m, measured from the high tide line and the banks of rivers to where there is tidal influence and navigable lakes. Two years later, the regulation (DS No. 015–2014) of this standard defines the coastal area as the “space covered by the aquatic strip of five nautical miles measured from the low-water line to inland waters (according to the UNCLOS), including the islands and islets and the coastal strip; therefore, the marshes, the lagoons, and the vertical cliffs that are in contact with the sea are considered to be in this zone. Therefore, it can be affirmed that in Peru the coast is defined from the point of view of safety, also differentiating ecological, geomorphological and socioeconomic aspects.

On the Iberian Peninsula, a Public Domain (PD) is defined as including both the terrestrial strip and the marine strip. In Portugal, arbitrary measures are used to delimit it - 50 m from the high tide line. Subsequently, something similar has happened with the formulation of the Maritime Spatial Plan and in the Proposal of Law 133/XII (Law No. 17/2014, Bases of the Management Policy and management of the national maritime space). Frazão Santos et al. (2014) question whether in both cases, the conservation of good environmental status or so-called blue growth was prioritized. They also consider that sustainability seems to be the underlying principle, since the ecosystem approach is recognized as fundamental, but that in practice environmental quality seems to have less significance than economic objectives.

In Spain, the length varies depending on the point at which the Inland Limit of the Shore (LIRM) is located. This is fixed at the place where waves have reach in the biggest known storms or where there are

sands of marine origin. This definition of the Maritime Terrestrial Public Domain (MTPD) has not changed since 1988, the year in which it was defined for the first time. Almost three decades later, in 2013, the Spanish law was modified, but without making changes to expand the MTPD, nor in the consideration of other definition criteria more in line with the protection of the coast. Even climate change is poorly explained in the current legal planning of coasts, unlike hydrological planning, which is included, despite its complexity (Roca et al., 2018). When comparing the two legal texts, it becomes clear that in Spain an opportunity to better guarantee the stability of the coast has been missed. In this sense, the new legislation harms the integrity and privatizes the public domain. The current Spanish coastal law (2/2013) increases the concession term to certain buildings (destined for use for housing and tourism) to 75 years that remain in the MTPD. The 1988 law granted them a 30-year concession, which expired in 2018. It must be considered here that these facilities are located on the first meters of the coast, on dunes and on the beach itself.

In both regulations however, the main objective is stated as being to safeguard its public character, which is an exceptional opportunity to intervene in the coastal zone since a territory is declared as inalienable, immune from seizure and imprescriptible. Therefore, the objectives favor the collective use of resources and guarantee direct and free access to the sea. However, the common use must be in accordance with the type of the asset (e.g. touristic and recreational use). But the pressure exerted by certain economic activities has been of such magnitude in some areas of the peninsular coast, that it is preventing this heritage of incalculable value from being conserved and, also, that some stretches of coast have become privatized.

It must be recognized that tourism makes an important contribution to the economies of certain territories, especially “sun and beach”, which uses maritime-terrestrial public domain areas. In their study on the system of concessions on Mediterranean beaches in Spain, Palazón et al. (2018) concluded that for the sustainable management of these areas it is necessary to link their physical-natural characteristics. This would achieve a balance between the natural, economic and social aspects of the territory and ensure that the quality of beaches does not decrease. In this sense, an issue to be taken into account is that of real estate, which is associated with this type of tourism, and is where the main threat lies for the conservation of natural attributes of the coast. A relationship that is not always satisfactory between the socio-environmental costs, of exclusively public origin, compared with the obtaining of formidable economic benefits on the part of private initiatives. The regeneration of beaches or the installation of protective barriers are the most common measures against erosion in both countries, which require large investments (Cardoso et al., 2019).

Both regulations include a public domain protection zone. These lands are generally privately owned, but have restrictions on use (Negro et al., 2014). They are defined by arbitrary measures, the length of the strip varying from 20 to 100 m, depending on whether the classification of land is urban or non-developable, respectively. This metric variation depending on land use, in the Spanish case, is explained by the fact that the legislator has never proposed adaptive measures and strategies of controlled withdrawal for prevention or intervention against coastal risk. This would consist of planning an inland displacement of those buildings and facilities that are most vulnerable in terms of flood risk and more susceptible to erosion of the coast.

Finally, in Spain, as in the rest of Ibero-American countries, a one-dimensional vision of coastal protection prevails. This is due to several factors: 1) the lack of awareness on the part of society and managers of the implications of degradation of natural defenses provided by coastal ecosystems; 2) the tradition that, almost all plausible protection measures come from the engineering of public works (Williams et al., 2018, Rangel-Buitrago et al., 2018a); 3) deficient and poor planning decisions that allow construction in high risk areas; 4) politicians subject to conflicts of interest and priority given to private property versus long term maintenance of ecosystem services (Neal et al., 2018); and 5) the

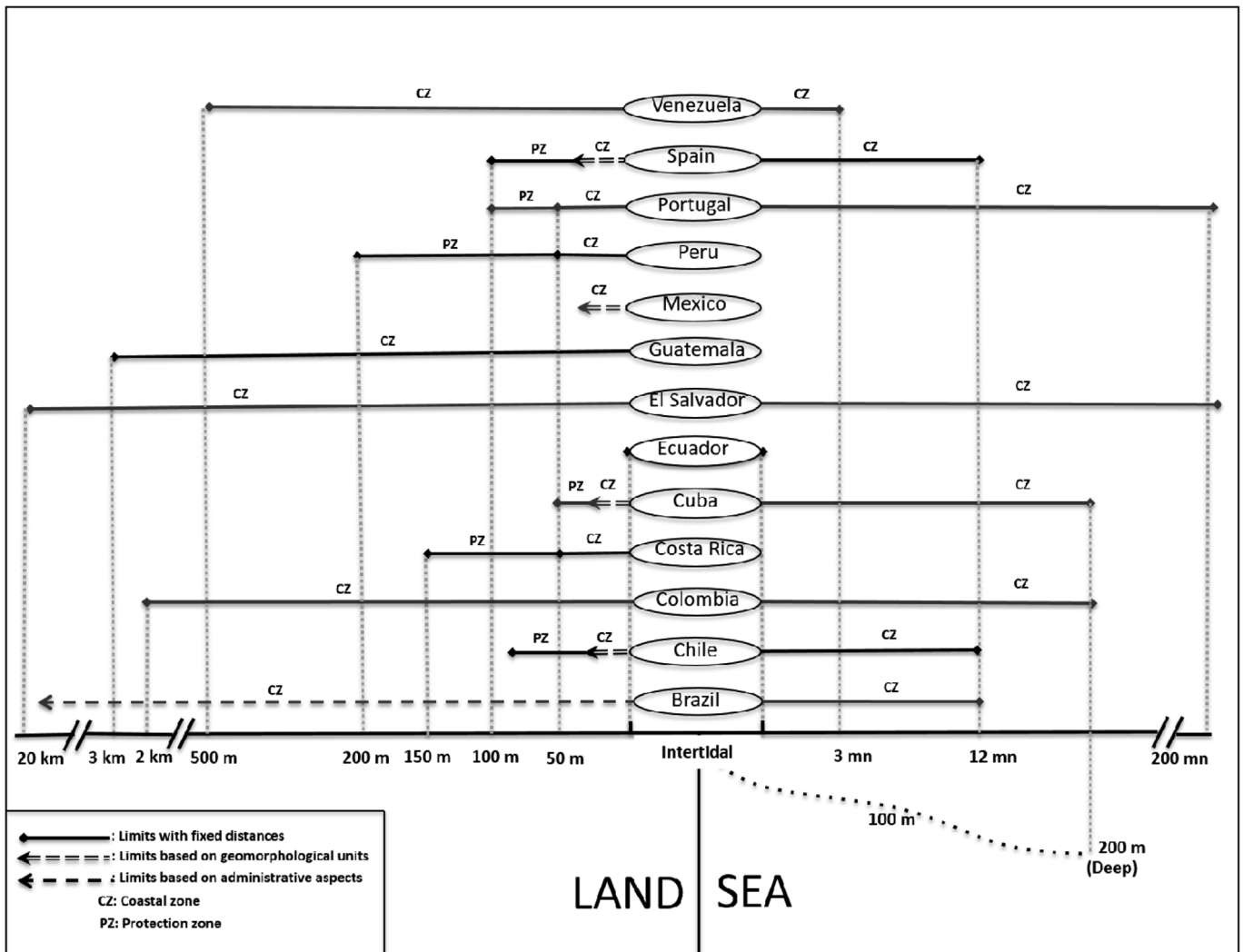


Fig. 1. The regulatory boundaries of the coastal zone in Ibero-America.

refusal to consider, as a measure of action, the elimination of infrastructure, buildings and facilities in the most vulnerable locations. In fact, on a global scale, this vision is causing serious damage to natural coastal ecosystems and compromising their ability to adapt and survive rising sea levels (Cooper et al., 2016).

Fig. 1 shows that there is not much variety in proposals of geographic scope in regulations. However, international organizations and academia recommend the incorporation of management by ecosystems, taking into account the vulnerability of the coast and the key variables related to the current climate change scenarios.

The incorporation of management by ecosystems would require an extension to the limits of the geographic scope, rendering management more complex. Additionally, the current administrative structure and competence demonstrates strong inertia that tends to resist changes, this makes the acceptance of new definition criteria difficult. Moreover, the responsibilities for the different environments (coast, watersheds and marine environment) are usually attributed to various administrative units. This division of competences hinders the development of integrated management systems when the geographical scope is shared.

However, in the marine environment the limit of the Territorial Sea is usually used. After more than half a century of uncertainty, the results of the application of UNCLOS seem adequate (Brown, 1981). The recognition of a Territorial Sea of 12 nautical miles according to Article three, of said convention, which provides that every State has the right to establish the extent of its Territorial Sea to a limit not exceeding 12

nautical miles, has avoided many conflicts between Nations. Moreover, it can be considered as a factor of economic growth, which has facilitated the management of the coastal-marine environment and has been the cornerstone of maritime spatial planning (Kastrisios and Tsoulos, 2016). Similarly, the ocean depths of 100–200 m and the continental or insular shelf are used for the establishment of limits in the marine environment. However, as technological capabilities to exploit the ocean improve, it is necessary to review the jurisdictional scope within which the legislation is applied. For example, at present, offshore wind farms are being planned in deeper waters than a decade ago in European countries (Portman et al., 2009).

The difficulty to agree on the definition of this complex area was already presented in a compilation of geographical limits of various coastal management programs in different countries (Sorensen et al., 1990). Proof of this is that most of the regulations reviewed, opt to use metric criteria, especially in the terrestrial zone, from the peak spring tide line: Chile, Costa Rica, Spain, Guatemala, Mexico, Portugal and Peru. However, administrative limits are also used in other cases, such as Brazil. However, it is noteworthy that on rare occasions physical-natural criteria are used, as in the legislation of Cuba and, to a certain extent, in Colombia. The Colombian Decree defines the Coastal Environmental Unit as an “Area of the coastal zone defined geographically for its management, which contains ecosystems with their own and distinctive characteristics, with similar conditions and

connectivity in terms of their structural and functional aspects". The law establishes 10 Coastal Environmental Units in the country. It is probable that the motive was to facilitate the task of the legislator, preferring to take into account implicitly the physical-natural characteristics within a range of measurement, instead of having to define and justify environments and processes. According to Milanés et al. (2019), the geomorphological and anthropogenic aspects are not completely connected when delimiting coastal units. Geographical approaches are taken into account, solely to establish limits in the direction towards land, while arbitrary criteria are chosen at the coastal edge and in the marine environment. The problem is that they ignore the physical and administrative heterogeneity of coastal zones, thus preventing the implementation of integrated long-term management (Sas et al., 2010). These territorial boundaries, which eliminate ecological interaction between marine species and the ecological conditions of their physical environment, have been adopted by most countries (Tanaka, 2004). This suggests that those responsible for coastal policies are not aware of the need to balance the politically functional and operational limits that are established in an arbitrary manner. They consider that the coast as homogeneous, without taking into account the physical and socio-economic characteristics.

Rangel-Buitrago et al. (2018a) recognize that the current approach, in which protection is commonly provided at the expense of citizens, reflects how little has been learned from previous poor management practices. We affirm that traditional methods of defense have done more harm than good to the protection of ecosystems. This implies that it is necessary to restore the habitats that serve as natural protection of the coast. We would go so far as to propose the elimination of anthropogenic structures that block the transport of sediments through coastal systems. In other words, intervention should be targeted at the causes of erosion, in an integrated manner, and not only as a one-off in specific places (Rangel-Buitrago et al., 2018b).

#### 4. Conclusions

Flexibility when establishing criteria for definition of the coastal geographical area, far from being an inconvenience, could be interpreted as an opportunity. Among other reasons, because it allows each state or region to adapt the limits according to their own context.

The search for an alternative to the current management of coasts should be considered as urgent. It is important that a new strategy be introduced that takes into account the current conditions of human occupation and erosion processes. Considering the traditional methods of defense have not been able to stop these processes, it is necessary to employ soft prevention alternatives and to provide new guidelines for management (Rangel-Buitrago et al., 2018a).

However, it is possible that in some regions, reconsideration of coastal limits, reconciling the administrative limits with those that use ecosystem criteria, is no longer sufficient. The coastal areas established by legislation are very narrow fringes. The acceleration and the crashing of waves over the coastal barrier are two of the main processes that threaten coastal structures, cause floods, the destruction of properties and ecosystems, and harm people. Management efforts should focus on the prevention of risks and the precautionary principle in conditions of uncertainty. In general, the short-term vision of regulations in the Ibero-American region will lead to environmental degradation, coastal erosion and the reduction of resilience to climate change. In addition, future scenarios of population growth on the coast and rising sea levels in areas where the demand for space will be increasingly urgent, the inclusion of imminent adaptation measures is required, applying scientific and universal criteria. Of all the laws analyzed, the one that would facilitate proper management of the coast against the effects of climate change is the Decree of Colombia, as it considers broad limits and uses them to identify its Coastal Environmental Units.

After this analysis, we propose that coastal area that allows risk

management and adaptation to climate change would be: several kilometers on land and 200 nautical miles at sea. To propose these limits the following reasons are stated:

In the land zone: Two measures of action must be taken into account: 1. A zone of exclusion must be favored in critical areas and vulnerable to the risks of coastal erosion. 2. Sufficient space must be guaranteed to carry out managed retreat to take anticipatory measures for the effects of climate change. This strategy consists of displacement of equipment, buildings and infrastructures destined for public uses and human activities in a direction perpendicular to the shoreline to land, in order to facilitate the process of re-naturalization of the areas with the highest risk of flooding. And, in addition, with the aim of protecting human lives and material goods. In short, these two measures of action could not be launched within a few hundred meters, as is taken into account in most regulations. It is especially necessary in areas that are not yet fully urbanized.

In the marine zone: The dimension of the ecosystem must be considered. Scientific criteria can be used to identify important biological and ecological areas that need special protection. The criteria of the CBD (2004) can be applied: uniqueness or rarity; special importance for life history stages of species; importance for threatened, endangered species and/or habitats; vulnerability, fragility, sensitivity or slow recovery; biological productivity; biological diversity and naturalness. In addition, it is necessary to study the influence of the marine dynamic processes that condition species and habitats (currents, sediment transport, dispersal of larvae, etc.).

The scope of the limits with ecosystem criteria will not coincide with the administrative limits of a country, due to the distribution of competencies in international waters. Therefore, it is proposed to use the 200 mn of the EEZ or to refer to the continental shelf up to the 200 m isobath. Because this would ensure a better conservation of ecosystems and natural resources. But also, because it is an essential area to develop various human activities (extractive fishing, maritime transport, oil extraction, etc.).

There is, however, no doubt that for such political will to exist, it is absolutely necessary to develop a communication strategy for society. Citizens are not aware of the current and future vulnerability of these environments (Neal et al., 2018); or they have different perceptions of natural hazards. The characteristics of risk perception seem to depend on attachment to a place, the underestimation of probability of impact and lessons learned, and inherent cultural aspects (Costas and FerreiraMartinez, 2015 & Boyer-Villemaire et al., 2014).

Taking into account all the uncertainties that exist (environmental, social and economic impacts), anticipatory measures must be considered for the effects of climate change, as well as adaptation measures. As these uncertainties depend on the variable of time. Therefore, the question of this challenge is how, among everyone involved (politicians, managers, citizens and scientists) the future of the coast is decided.

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