



## Novel method to delimitate and demarcate coastal zone boundaries



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### ABSTRACT

Different legal frameworks and concepts have been used to establish coastal zone boundaries. Integrated Coastal Zone Management use some criteria, while Land-Use Planning use a different criteria. A critical analysis about this topic is done in the present study, with the aim of proposing a novel method for delimitation and demarcation of coastal zone boundaries. The method offers an integrated perspective regarding the river basin, the coastal zone, and their corresponding economic zones. Moreover, it is comprised of dependent and independent variables, representing useful decision-making tools for applying Integrated Coastal Zone Management and Land-Use Planning initiatives. The concepts of *Primary Environmental Coastal Units for Integrated Management (PECUIM)* and *Basic Environmental Coastal Units for Integrated Management and Land-Use Planning (BECUIMLUP)* were proposed and applied in Cuba, where twenty-three *PECUIM* and four *BECUIMLUP* were demarcated and delimitated. At the end of this paper, the importance of integrated criteria for coastal zone boundaries is concluded and demonstrated.

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### 1. Introduction

Integration of Land-Use Planning (L-UP) and Integrated Coastal Zone Management (ICZM) continues being a challenge for planners, practitioners and decision-makers. It is greatly needed, to guarantee sustainable development of coastal ecosystems. Despite more than 40 years of ICZM and a century of LU-P, establishment of appropriate geographical boundaries in coastal zones is still a lacking in both approaches (Milanés, 2012a; Botero et al., 2016).

The concept of coastal zone refers to a geographic space which plays an important role in territorial planning (Sorensen, 1993). Different regulations establish boundaries at coastal zones for applying Integrated Coastal Zone Management (ICZM) programs (Milanés and Pérez, 2012; Botero et al., 2016). Nevertheless, there is a noticeable absence of work that aims to establish proactive methods to delimitate boundaries for ICZM initiatives (Balaguer et al., 2008). At the same time, depending on the focus of interest and availability of useful data, some countries give different definitions for coastal zone boundaries (SAC, 2012).

There are specific international policies and legal frameworks to

establish marine and terrestrial limits with the aim of planning or managing coastal zones, using varied terminology, such as: “*Delimitation of Coastal Zones*” (GORC, 2000), “*Demarcation of Marine-Terrestrial Zones for Public Use*” (LEC, 1988; IGN., 2004) “*Coastal Delineation*” (Steer et al., 1997), “*Delineation of Coastal Bordering*” (Martins, 1997, 2010), “*Delimitation of Technical Brands*” (Barragán, 2003), and “*Area for Public Use*” (Macías, 2000). Also “*zoning*” is used when delimitating coastal zones (Cicin Sain and Knecht, 1998), and “*Protection Zone*” is used in Decree Law 212 (Cuban Coastal Law), refers to land ordering or planning of coastal zones (GORC, 2000; Milanés et al., 2014). Additionally, the terms “*Restriction Zone*”, “*Exclusion Zone*” or “*Protection Belt*” are used in countries such as Brazil, Poland and Denmark. Several types of coastal zones, such as mangrove swamps, lagoons, beaches, cliffs, as well as their corresponding boundaries, are given to guarantee coastal zone protection (GORC, 2000).

According to conceptual and terminological reviews, various criteria have been used to establish marine and land boundaries in coastal zones for ICZM and Land-Use Planning (L-UP) (IUCN, 1983); (OECD, 1991); (PNUMA, 1992); (World Bank, 1993); (WCCR, 1993), (See Appendix A for more details). Some studies have focused their analysis on establishing coastal zone boundaries from an ICZM perspective, but most of them are exclusively based on general problems influencing the terrestrial area, or on specific problems, like resource-use conflicts (IOC UNESCO, 1997; Boesch, 2001). Other studies analyze distinctive elements of the terrestrial ecosystems as

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related to coastal bordering, edaphological characteristics and risk problems in case of coastal flooding (MMA–IGAC, 2000; Areces et al., 2011). Most traditional studies are referred to administrative divisions of local areas or regions (Barragán, 2004; Sardá et al., 2005; Brenner et al., 2006; GORC, 2010), and have to do with delimitation following law regulations and coastal policies of the corresponding countries (Steer et al., 1997; GORC, 2000; GORC, 2010; MMA, 2001).

Significant studies have referred to the geomorphic and physiographic characteristics and to the homogeneous environmental management units (Amir, 1987; IOC-UNESCO, 1997; Brenner et al., 2006; Balaguer et al., 2008; Steer et al., 1997; Obllurys et al., 2009). “Ecological Unit” (MMA–IGAC, 2000), and “Landscape Unit” (Mateo, 1991, 2000; Quintela, 1995; NC 93-06-101, 1987 and, Salinas, 2004) are concepts mostly used following the landscape perspective (Mateo, 2000; Salinas, 2004) and the ecological approach (Gerhartz et al., 2008; Obllurys et al., 2009) when establishing only terrestrial boundaries. In Colombia, new concepts such as: “Integral Units for Planning and Land–Environmental Spatial Planning”, “Coastal and/or Oceanic Environmental Units” (also called “Coastal Environmental Unit”), and “Integrated Management Unit” are being used for ICZM (MADS, 2013), while the term “Zones Under an Integrated Coastal Management Regime” is used in Cuba. In majority of cases, definition of “homogeneous units” was done by using map-crossing with geographical information systems (Ramon et al., 2012). Additionally, some institutions do not even mention the way of establishing boundaries (PNUMA, 1992; WCCR, 1993).

In the present research work “demarcation” represents the coastal zone boundary of the selected area for applying ICZM programs (Fig. 1) and “delimitation” represents the marine-land boundary for applying L-UP (Fig. 2). Consequently, our research wanted to integrate ICZM and L-UP backgrounds to provide

theoretical and methodological framework for demarcation and delimitation of coastal zone boundaries, and also to reveal the way of carrying them out into practice.

## 2. Background

Some of the most representative ICZM methods developed in the nineties were reviewed and analyzed in this research work (Pernetta and Elder, 1993; Olsen, 1993; Clark, 1996; GESAMP, 1996; Cicin-Sain and Knecht, 1998; Olsen et al., 1999; Kay and Alder, 1999), since they constitute the basis of most of the present ICZM initiatives all over the world. As an example, one of the methods defines the geographical limits for territorial planning according to the main identified problems to be solved (Barragán, 2003). Another method, in Colombia, proposes an approach where the use of L-UP in ICZM programs is included, and analysis of coastal landscapes leads to divide terrestrial areas into landscape units (Alonso et al., 2003). However, the L-UP tool takes only into account management units demarcated by the Coastal Colombian Policy (MMA, 2001; CCO, 2007), therefore, not having enough clarity regarding the necessary procedure to determine marine-land boundaries.

An interesting example is given in the Process of Declaring Zones Under an Integrated Coastal Management Regime to promote ICZM in Cuba. This process was applied in different zones of the country and 15 ICZM programs were obtained as a result (Salabarría and Brito, 2011; Yola et al., 2010). In a review of nine ICZM Cuban programs, homogenous variables or criteria were given to demarcate coastal zone boundaries (CITMA, 2009a, 2009b; 2009c, 2010a; 2010b, 2010c; Prado et al., 2008; Rodríguez et al., 2010a, 2010b.) In four programs, boundaries were established following political-administrative criteria, and only the



Fig. 1. Demarcation of coastal zone boundaries for ICZM.

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