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Evaluating the official achievement of Aichi Target 11 for West African countries: A twofold challenge of accuracy and catching-up

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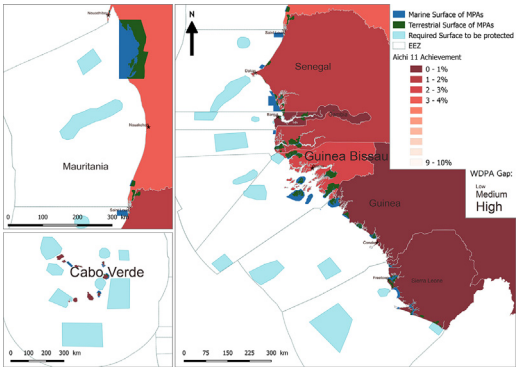
HIGHLIGHTS

- Calculated MPA areas are well below what is announced in the WDPA.
- The seven African countries studied are below Aichi 11 Target.
- The numerous sources of dysfunction of the WDPA come mainly from repeated counting.
- To reach Aichi Target 11, these countries need to shift towards large offshore MPAs.

GRAPHICAL ABSTRACT



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ABSTRACT

Since Aichi Target 11 imposes 10% of national protected marine surface by 2020, the least developed countries have particularly shortcomings towards this goal, this article evaluates the progress of seven West African countries. We compared the area reportedly protected sites from two different sources, the world database on protected areas (WDPA) – which is the official tool to monitor the Aichi 11 Achievements – and the West African Marine Protected Area Network, which conducted a comprehensive survey in collaboration with the national institutions in charge of MPAs. Overall, the countries included in this study are unlikely to achieve the Aichi target. Comparing WDPA protected area figures against database created directly from national data showed large discrepancies. According to national data, Mauritania (3.71%) and Guinea-Bissau (2.15%) had the highest protected areas. Senegal had 1.61% of his EEZ under protection, while other countries had <1%. The difference between WDPA and national data was high with Guinea-Bissau already at 10% of EEZ protected areas status according to the WDPA. WDPA overestimated 5935 km^2 of MPAs, corresponding to 41% of the actual total area. Possible explanations for the differences include: countries not transmitting information or doing so incorrectly; methodological transformations of data are inducing errors; and multiple MPA statutes leading to double counting of protected areas. This study also shows that for these countries, to achieve Aichi Target 11, large offshore MPAs are the only viable option, and therefore identifies potential sites, that should be considered in addition to conservation of coastal zones. However, their viability may be constrained due to oil activities and lucrative fishing.

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The increasingly anthropized littoral zone offers less space favourable to MPAs, while 138,723 km^2 still need to be covered in these countries to reach 10% of marine protected area.

1. Introduction

Aichi Target 11[1] is of particular importance for the protection of marine ecosystems (Humphreys and Herbert, 2018; Naoe et al., 2015; Woodley et al., 2012). It states that: "*By 2020, at least 17% of terrestrial and inland waters and 10% of marine and coastal areas […] are conserved through ecologically representative and well-connected networks of protected areas managed efficiently and equitably and other effective conservation measures by zone*". The World Database on Protected Areas' (WDPA)[2] is a global database of country's report their protected areas to and is the reference instrument progress towards Aichi Target 11 is assessed (Smallhorn-West and Govan, 2018; Thomas et al., 2014). Validating the information in the WDPA is necessary for robust assessment of progress towards Target 11.

The Aichi Targets are part of the Convention on Biological Diversity (CBD) and the targets are international referents signatory countries aim for. Many authors have already focused on Aichi Target 11, including the representativeness of marine cover (Butchart et al., 2015; Spalding et al., 2014), the factors determining its progression (Fox et al., 2012; Maestro et al., 2019; Tiquio et al., 2017) and the growth rate of these marine protected areas (MPAS) (Amengual and Alvarez-Berastegui, 2018; Sala et al., 2018). It appears that these areas are poorly distributed according to ecoregions and species. In addition, Aichi Target 11 would not be achieved by 2020, especially in poorer countries.

To track progress towards the Targets and the underlying conservation motives of the convention itself, the marine protection data must be properly recorded and documented (Knowles et al., 2015; Smallhorn-West and Govan, 2018). However, issues with the WDPA have been raised and Thomas et al. (2014) highlighted protected marine area recorded in the WDPA worldwide is lower than the data of the same base when the terrestrial areas of the MPAs are removed.[3] In addition, some MPAs that have not yet been implemented may be counted (Sala et al., 2018), as well as protected areas whose low status does not justify their accounting as protected areas (Han et al., 2017; Rodriguez-Rodriguez et al. 2016; Sala et al., 2018). Some other inaccuracies are also present in this database: double counting, erroneous outlines of MPAs, absence of outlines, etc. (Jenkins and Joppa, 2009; Knowles et al., 2015; Spalding et al., 2013). Ensuring the accuracy of WDPA data by checking it against other data sources improves assessment of national and global progress towards Aichi Targets.

The objective of this article is: 1) to measure the differential between the WDPA and those of coastal countries and 2) to identify the reasons for discrepancies and suggest ways to both improve marine surface coverage protected and the accuracy of the WDPA. The study encompasses Mauritania, Cabo Verde, Senegal, Gambia, Guinea Bissau, Guinea and Sierra Leone, who are members of the Regional Network of Marine Protected Areas in West Africa (RAMPAO) but haven't yet had a detailed review of their MPAs surfaces. These countries are globally little advanced towards Aichi Target 11, as are many other poor countries (Butchart et al., 2015; Tiquio et al., 2017). In addition, the quality of the data contained in the WDPA is relatively low for these countries (Cros et al., 2014; Knowles et al., 2015), since the information transmitted by the national institutions in charge of protected areas are obsolete and poorly verified subsequently by WDPA (UNEP-WCMC, 2016). In collaboration with national institutions in charge of protected areas, a detailed database of MPAs was set-up in 2017 and 2018 within the IUCN regional marine and coastal thematic program in Central and West Africa (Failler et al., 2018). Located at the interface between marine and terrestrial ecosystems, these MPAs concern both conservation and public policy issues (Humphreys and Herbert, 2018).

The novelty of this work is in its comprehensive and unpublished inventory of the MPAs and their surfaces along the West African coastline. It also presents an unprecedented scale of analysis[4] of the gap between Aichi 11 Target and the actual situation of seven countries. Analysis of the case study countries reports on the complexity of integrating national data on protected areas into the international WDPA data bank, illustrated by numerous examples of misrepresentations. Finally, it provides an innovative spatial analysis that demonstrates the importance of large offshore MPAs to achieve Aichi Target 11.

This study is structured in three parts; 1) a detailed description of data collection and the mapping of MPAs and subsequent calculation of total and exclusively marine surface areas; 2) presents the main results relating to the national coverage of MPAs from different reference systems (WDPA database, total areas of MPAs, exclusively marine areas); 3) and a discussion of the causes of the discrepancies between officially reported MPA data in countries and those contained in the WDPA with recommendations to improve the accuracy of the latter. The discussion also reviews the challenges faced by Regional Network of MPAs in West Africa (RAMPAO) countries in meeting the Aichi Target 11 and potential avenues that could be used to successfully meet it.

2. Material and methods

To create a robust dataset of RAMPAO MPAs to evaluate WDPA data against, we first built a database from a census of all the MPAs located on the continental and insular West African coast. We then mapped and calculated their total surface, marine and terrestrial areas, before comparing the areas from this spatial mapping with those reported in the WDPA.

2.1. The world database on protected areas

The WDPA is the reference for assessing country progress towards the CBD objectives, including Aichi's Target 11. Created in 1981[5] and freely accessible, the WDPA lists all the existing protected areas in the world and related information: status, geographical location, contour, date of creation, area, management information, etc. A presentation by country is also available, including the total area of protected areas,

[1] During the sixth meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) in 2010, member countries agreed to put in place the twenty Aichi targets (Doherty et al., 2018; Velázquez Gomar, 2014). The Aichi Targets are general goals that should guide the policy of the committed countries. Acknowledging the lack of effectiveness of the measures taken so far, the Aichi Targets should encourage the countries concerned to "*take effective and urgent measures to halt the loss of biodiversity, in order to ensure that, by 2020, ecosystems are resilient and continue to provide essential services*".

[2] See: www.Protectedplanet.net. This database is run in partnership by the United Nations Environment Program (UNEP) and the World Commission on Protected Areas of the International Union for Conservation of Nature (IUCN).

[3] The author only used WDPA data and did not develop her work across continents or regions.

[4] Analyzes of protected marine surfaces have already been carried out at the level of a group of countries by Amengual and Alvarez-Berastegui (2018) in Mediterranean Sea and by Knowles et al. (2015) in Caribbean Sea. However, there were several richer countries in the case of Amengual and Alvarez-Berastegui (2018), and only insular territories in the case of Knowles et al. (2015).

[5] As part of a project between the IUCN World Commission on Protected Areas and the United Nations Environment Program (UNEP). See: https://www.iucn.org/theme/protected-areas/our-work/quality-and-effectiveness/world-database-protected-areas-wdpa.

the protected marine area and the ratio of protected area to the country's surface area (including the ratio of marine protected area to the EEZ). The information and data in the WDPA are provided by national administrations or by international organizations (RAMSAR, WWF, IUCN, etc.). However, MPAs in the WDPA can have errors (Cros et al., 2014) when the indicated surface does not correspond to the contour of the site or the outline is imprecise or non-existent.[6] In addition, for West Africa, the list of protected areas is not complete and sometimes obsolete, thus affecting the calculation of total area (see section "Results").

The WDPA calculates the national marine surface occupied by the MPAs by cumulating their total surface area before subtracting the areas located upstream of the coastline. The geo-referenced base of the *Flanders Marine Institute* is used to delimit what belongs to the terrestrial or marine. The version used by the WDPA is that of 2014 but since several revisions of the EEZ and coastline boundaries have been made, WDPA data may be considered partially obsolete (notably the estuaries of the Casamance Rivers, Gambia, Rio Geba Rivers in the region[7]). In addition, when MPA contour information is not available, the WDPA scans a "buffer zone" of arbitrary radius, centred on a point representing the protected area.[8] This method introduces a bias in the calculation of surfaces because the contours of the MPAs do not describe a perfect circle around a specific point.

2.2. Creating a comprehensive survey of RAMPAO MPAs

A comprehensive survey of MPAs for the seven countries in the study area was conducted in 2017 and 2018 as part of IUCN West Africa's "coastal & marine" thematic program. The seven countries included in this study were the RAMPAO members: Mauritania, Senegal, Cabo Verde, Gambia, Guinea Bissau, Guinea and Sierra Leone. Latest information on MPA contours, statutes and other information were collected from the national institutions responsible for their administration in each of the 7 countries: cartographic documents, management plans, creation decrees, scientific publications, etc. In total, 88 MPAs of different status were identified, mainly national parks, community reserves or community heritage areas.[9]

This list was used to identify the 'reference state' for RAMPAO MPAs in 2018 and shows the level of network coverage. Additional information on the type of surface and management style was added by collecting the management plans and other statutory and informational documents of the 32 MPAs of this network. This detailed database ('comprehensive survey') is robustly validated and was used as the comparison to evaluate of WDPA data.

2.3. Digitization and cartography of the comprehensive survey

The cartography of the 88 MPAs was carried out using QGIS open source software (version Essen 2.14.12) and base maps were generated from the comprehensive survey of MPAs. All files were used under the reference system WGS84, ref. 4326. For 50% of the MPAs, the digitization work had already been done by the administrations. Of these, only about half of them has maps which were able to be validated and these were directly imported into the database of this work. For the remaining MPAs, to fix their erroneous contours, we digitized their contours and remapped them. We also mapped the contours for the MPAs of which no geo-referenced information existed. In the rare cases where GPS coordinates or specific indications were missing (landmarks such as roads, rivers, coastline), we georeferenced the available map documents and then digitize the contours from existing indications.

2.4. Calculation of surfaces

We calculated the area of each MPAs from the maps using QGIS. The total area of MPAs and EEZs per country was done using the automatic surface calculation function. To identify the location of marine and terrestrial boundaries, we imported coastlines for the countries from the *Flanders Marine Institute*[10] 2018 database. The total area of the MPAs and the marine area were then compared to the area of the EEZ of each of the seven countries studied to calculate the percentage of protected area within the EEZ.

To isolate marine surfaces from total areas of MPAs, the "clipping" function was used to separate marine areas from terrestrial areas in the "vector" layer of MPA contours (see Thomas et al., 2014). The input layer was the total surface of the MPAs and the cutting layer was the EEZ, which had a precise digitization of the coastline[9] for each country. The new layer was called "Marine Surface of MPAs" as it corresponded to the contour of the marine surface of MPAs (see Fig. 1). An automatic surface calculation was performed for this new layer to determine the marine surface of each MPA.

Since there may be inaccuracies in the automatic surface calculation when using reference system like WGS84 (the surface unit is square degree), we validated the reliability of the QGIS automatic calculation function by using the QGIS individual metric surface calculation (which uses square meters). In every case, the contours of MPAs indicate a surface similar to that determined by the automatic calculation function (<0.5% of difference).

However, that the required data are difficult to obtain, and these data are sometimes insufficient to digitize the MPAs satisfactorily. In the present work, the MPAs in Sierra Leone are likely the least robust in the database, as the boundaries of which are not relatively precise (outline, census, date of creation, administrative status). In addition, there is limited access to information for some community nature reserves in Senegal.[11] In total, 14.8% of the MPAs'outlines should be improved in the future. Thus, the replicability of the work may be diminished. The current context in West African coastal countries, where human and technical capacities are weak (Antwi-Agyei et al., 2018) and where the scope of institutions is limited (UNDP, 2018), implies that reference data relating to MPAs are sometimes rare, scattered and erroneous (Bonnin et al., 2015; Knowles et al., 2015; UNEP, 2016; Vanhove et al., 2017).

2.5. Comparing the comprehensive survey and WDPA

To measure the progress of the countries towards Aichi Target 11 according to the comprehensive survey and the WDPA, we compared MPA data from the two sources using the metrics: 1) number of MPAs; 2) total area of the MPAs; 3) marine area of the MPAs. Despite the fact that both databases rely on data originated from national institutions, the data forming the comprehensive survey is sourced and verified directly from MPAs managers and national institutions. The data they provide are more up to date and of higher resolution than the data available in the WDPA.

[6] Examples: Diawling National Park (Mauritania) has an erroneous outline in the WDPA; the Gundjur/Fenyo Bolong Reserve (Gambia) has a correct outline in the WDPA but the indicated area does not correspond to the officially recognized one; the ornithological reserve of Kalissaye (Senegal) has no contour in the WDPA.

[7] Frequent incremental updates of coastline digitization can increase accuracy. In addition, recent physical shoreline changes along the shoreline with a dynamic profile are more likely to be digitized in more recent versions.

[8] See: https://protectedplanet.net/c/calculating-protected-area-coverage.

[9] RAMSAR sites, protected landscapes, hunting reserve, wildlife reserve, ornithological reserve, forest reserve.

[10] Flanders Marine Institute (2018). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 10.

[11] These are Darou Khoudoss, Guembeul, Gandon and Notto Gouye Diama Community Nature Reserves (CDNs) in Senegal, and sites of Sewa-Waanje, Bonthe, Lakes Mape & Mabesi, Sulima and Waterloo in Sierra Leone.

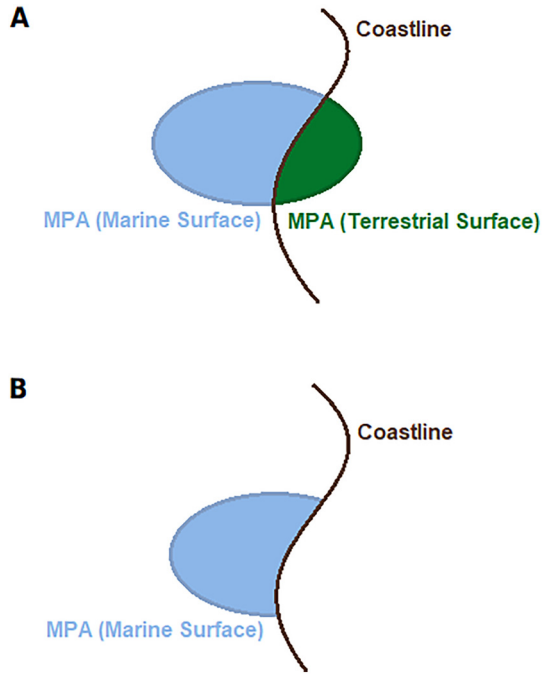

Fig. 1. Explanatory diagram of the cutting function. A) Before cutting; B) After cutting.

3. Results

The marine surface of MPAs accounts for 51.1% of the total MPA area in the comprehensive survey. Most of the MPAs in these countries (77 out of 88) are situated at the interface between terrestrial and marine areas. For example, the marine and terrestrial surface area in the Banc d'Arguin national park in Mauritania are pretty similar at 53% and 47% of the total MPA area, respectively. The same is true of the many MPAs located in the mangrove areas, from Casamance to southern Sierra Leone. Only 11 MPAs are entirely located upstream of the coastline, but there are no "far-shore" MPAs in the region (Fig. 2). These large land surfaces included in the MPAs of West Africa are a regional specificity. This is due to the presence of large habitats that are at the interface between land and sea, such as mangroves, lagoons and small islands.

3.1. Comparing MPA coverage in the WDPA and the comprehensive survey

3.1.1. Number of MPAs and total area in the comprehensive survey and the WDPA

Only 54 RAMPAO MPAs are listed in the WDPA but 88 are identified in the validated comprehensive survey dataset complied from individual countries (Table 1). Paradoxically, the two countries with the most MPAs, Cabo Verde and Senegal, are the countries with the least reported MPAs in the WDPA. Several countries, such as Cabo Verde and Senegal, have not reported all of their MPAs to the WDPA (4 versus 29 for the first and 14 against 24 for the latter). Guinea-Bissau, meanwhile, reported more sites than those registered by its administration to the WDPA (8 against 6): the Varela and Rio Grande MPAs of Buba are only at the proposal stage and do not yet have an official status.

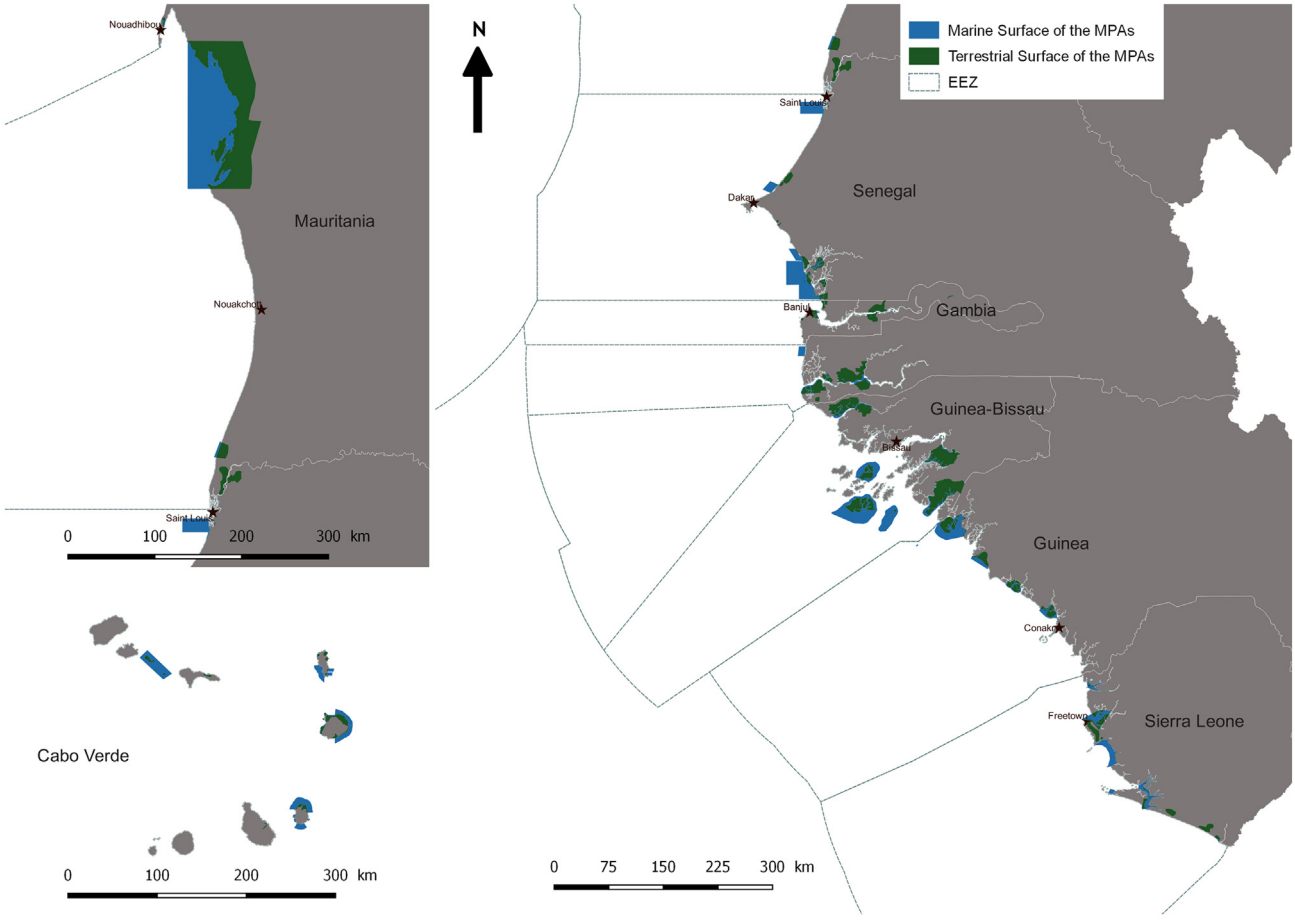

Fig. 2. Complete list and outlines of MPAs in West Africa.
Source: Own elaboration.

Table 1
MPA counting in West African countries and comparison with WDPA.

	Mauritania	Senegal	Cabo Verde	Gambia	Guinea-Bissau	Guinea	Sierra Leone	Total
EEZ (sq. km)	173,728	158,936	804,694	23,184	107,301	102,587	161,275	1,531,705
Number of officially recognized MPAs	5	24	29	8	6	6	10	88
Number of MPAs in WDPA	4	14	4	8	8 (−2)	6	10	54
Difference with WDPA	1	10	25	0	−2	0	0	34 (+2)
Total Surface of officially recognized MPAs [sq. km] (1)	12,521	4556	1448	464	5590	1871	1842	28,294
Marine Surface of officially recognized MPAs [sq. km] (2)	6450	2568	1101	23	2304	993	1008	14,447
Surface of MPAs in WDPA [sq. km] (3)	6488	1766	5	16	10,661	583	863	20,382
Difference between (1) and (3)	6033	2790	1443	448	−5071	1288	979	7912
Difference between (2) and (3)	−38	802	1096	7	−8357	410	145	−5935

Source: WDPA and own elaboration.

The total MPA area as recorded in the WDPA are different from area calculated by the comprehensive survey. The total and marine areas of MPAs in the comprehensive survey are respectively 28,294 and 14,447 km^2 against 20,382 km^2 representing the total area in the WDPA (Table 1).[12] Some marine protected areas include a large land area, although the classification of these sites has generally been oriented towards marine resource management issues (Cros et al., 2014).

The sum of the total surface areas of officially recognized MPAs is 39% higher than that of the WDPA (28,294 against 20,382 km^2). With the exception of Guinea-Bissau, the total area of MPAs from the clean design base is still greater than the protected marine area indicated in the WDPA. For this country, the surface comprised in the WDPA is twice the size than that of the comprehensive survey. The most plausible explanation is in this case the repeated counting of MPAs that have several designations (Inscription on the list of wetlands of international importance - Ramsar sites and sites classified by UNESCO in addition to the statutes of the national administration, the addition of Varela and Rio Grande only slightly modifying the total).

3.1.2. The marine areas of MPAs in the comprehensive survey and the WDPA

The estimated marine area of MPAs in the comprehensive survey is 29% lower than that of the area recorded for MPAs in the WDPA (respectively 14,447 against 20,382 km^2). The area is relatively similar for Mauritania, but different for all other countries (Fig. 3).

Guinea-Bissau even presents an anomaly, namely a surface recorded in the WDPA >4 times higher than that of the marine surface of the comprehensive survey. There are several potential reasons for these discrepancies: 1) counting of MPAs whose status is not yet officially recognized (as mentioned above for the 2 MPAs in Guinea Bissau); 2) double counting for MPAs having several statutes (with the examples of Bijagos, Cantanhez, Cufada and Rio Cacheu in Guinea-Bissau); 3) the use of data from administrations that are imprecise or false (example of the outline of the Diawling National Park in Mauritania which has a different outline between the WDPA and the management plans) or the surface calculation (example of the Gundjur/Fenyo Bolong Reserve in the Gambia, which has twice the surface area in the WDPA and the management plans in relation to the actual area according to the maps in the same sources).

3.2. Achieving Aichi Target 11

According to the WDPA, Guinea-Bissau is the only country to have reached the 10% of EEZ designated as MPAs of Aichi Target 11. Mauritania's MPA coverage would actually be 4% of its EEZ. The other countries are even lower with Senegal at 1% and the remaining countries at <1%, with the exception of Cabo Verde that has a protected area ratio of 0%.

The coverage of MPAs towards Aichi Target 11 is lower when marine-only surfaces of officially recognized MPAs from the comprehensive survey are analysed (Fig. 3). No country reaches the target of 10% protected marine area. The entire marine surfaces of Guinea-Bissau MPAs are at 2%. Mauritania has the highest MPA area with just over 4% and is also similar to the reported figure in the WDPA. Senegal, Guinea, Sierra Leone and Cabo Verde see their surface increase significantly comparing to WDPA, but not above 2%. Paradoxically, Cabo Verde, which has the largest number of MPAs in the region, remains the country with the least protected marine cover (<1%).

When the areas of established MPAs are compared to the area the countries have pledged to protect, there are large differences in both percentage and absolute area (Fig. 4). To meet Aichi target 11 Cabo Verde must increase its MPAs by over 70 times, Gambia by a 100 times, Sierra Leone by 16 times, Guinea by >10 times, Guinea Bissau by 4.7 times and Senegal by 6.2 times. Even Mauritania, which has the largest MPA in Africa, has to almost triple its MPA to reach Aichi Target 11.

To meet Aichi Target 11, RAMPAO countries have to increase their MPA coverage, and the most viable way is through the creation of MPAs on the high seas. To illustrate how this could be achieved, we created hypothetical MPAs over the key marine pits and seamount environments (Tendeng et al., 2012). Fig. 5 shows the location of these additional MPAs alongside the existing MPAs. For all countries, the expansion of these MPAs would be on the high seas (Ban et al., 2017; Bastari et al., 2016). The coasts are not the most suitable MPA areas because of the presence of >60% of the population of these countries in the littoral fringe (Failler, 2015), even if these areas still require attention. They are also already the location of many protected areas and no longer able to accommodate new MPAs of significant size.[13]

4. Discussion

In terms of both the number of MPAs and the surface area, the results presented above show a substantial differential with what the WDPA can indicate in terms of countries reaching Aichi's Target 11. For this reason, causes of the vagueness of the WDPA must be considered. This especially requires understanding why countries are so far from this target and how the lack of organization in these countries impacts the accurate accounting of MPAs at the international level.

4.1. Accuracy and completeness of the WDPA

The differences between the WDPA data and the census of all officially recognized MPAs come from several causes:

- The countries transmit obsolete or wrong data (Han et al., 2017; Knowles et al., 2015; Smallhorn-West and Govan, 2018). As the

[12] The total area included in the WDPA is supposed to be exclusively marine.

[13] Except in Mauritania, where the coastline is still relatively unoccupied (particularly between Nouakchott and Ndiago, located at the southern limit of the Mauritanian coastline).

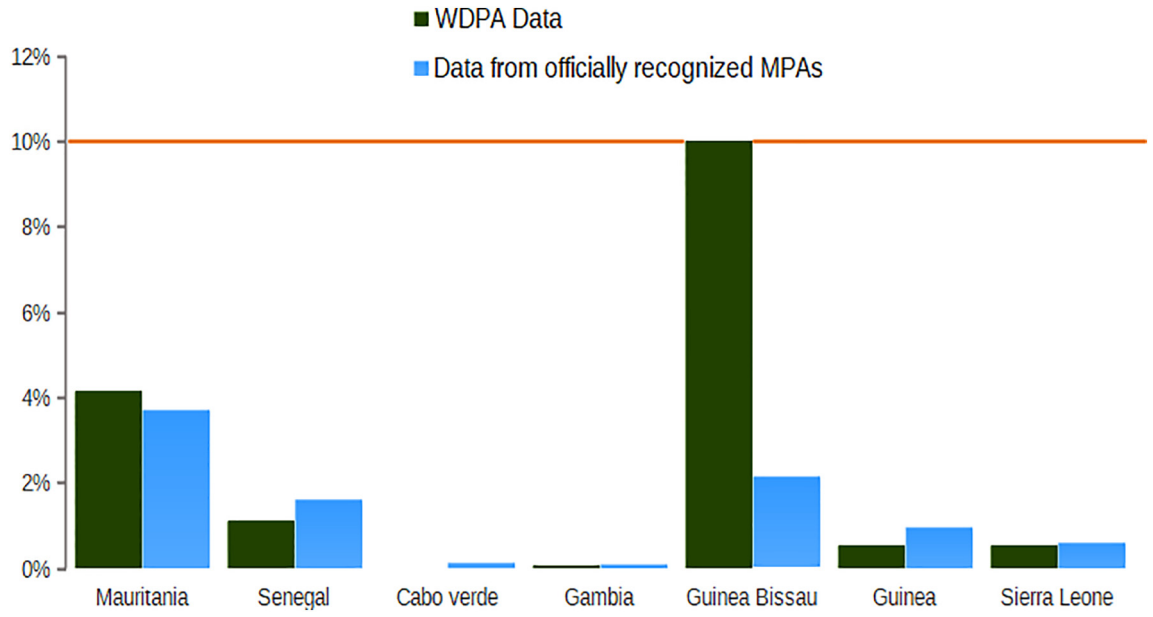

Fig. 3. Percentage of national area protected by MPAs within the EEZ. The mark (orange horizontal line) is 10%, to highlight Aichi Target 11. The area protected by MPAs is indicated for each country according to two scenarios: according to WDPA data (green) and according to the exclusively marine surface of the data recorded in this work (blue). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

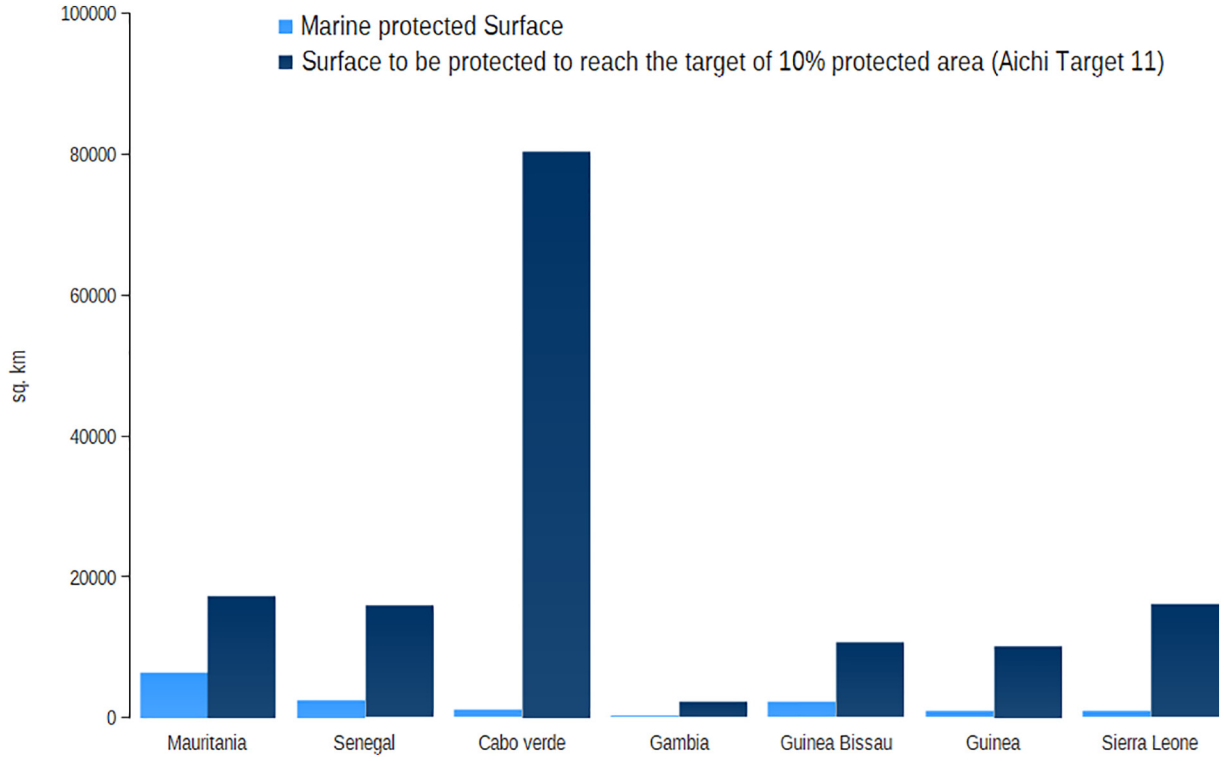

Fig. 4. Differential between the protected marine surface (light blue) and the total area still to be protected according to Aichi Target 11 (10% of the EEZ, dark blue). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

WDPA considers that these data have been verified by the countries concerned, there is only little verifications (UNEP-WCMC, 2016);
- the WDPA has accounted for MPAs whose status is not yet officially recognized ("proposed" status),[14] or whose status are insufficient in terms of conservation to be considered as protected areas (Han et al., 2017; Sala et al., 2018). Thus, data contained in WDPA may also result in over counting;
- when the WDPA does not have the outline of an MPA, it sometimes uses a simple surface calculation mode to get it: the scanning of a circular buffer zone around a reference point, the radius of which is determined arbitrarily.[15] As showed in the Fig. 6 for the Popenguine Reserve in Senegal, this may introduce a bias in the counting of

[14] This is the case for Rio Grande de Buba and Varela in Guinea Bissau (see: https://protectedplanet.net/search?country=Guinea-Bissau&main=country). However, in some cases, MPAs are designated as "proposed" in the WDPA but are also recognized in the comprehensive survey.

[15] See: https://protectedplanet.net/c/calculating-protected-area-coverage.

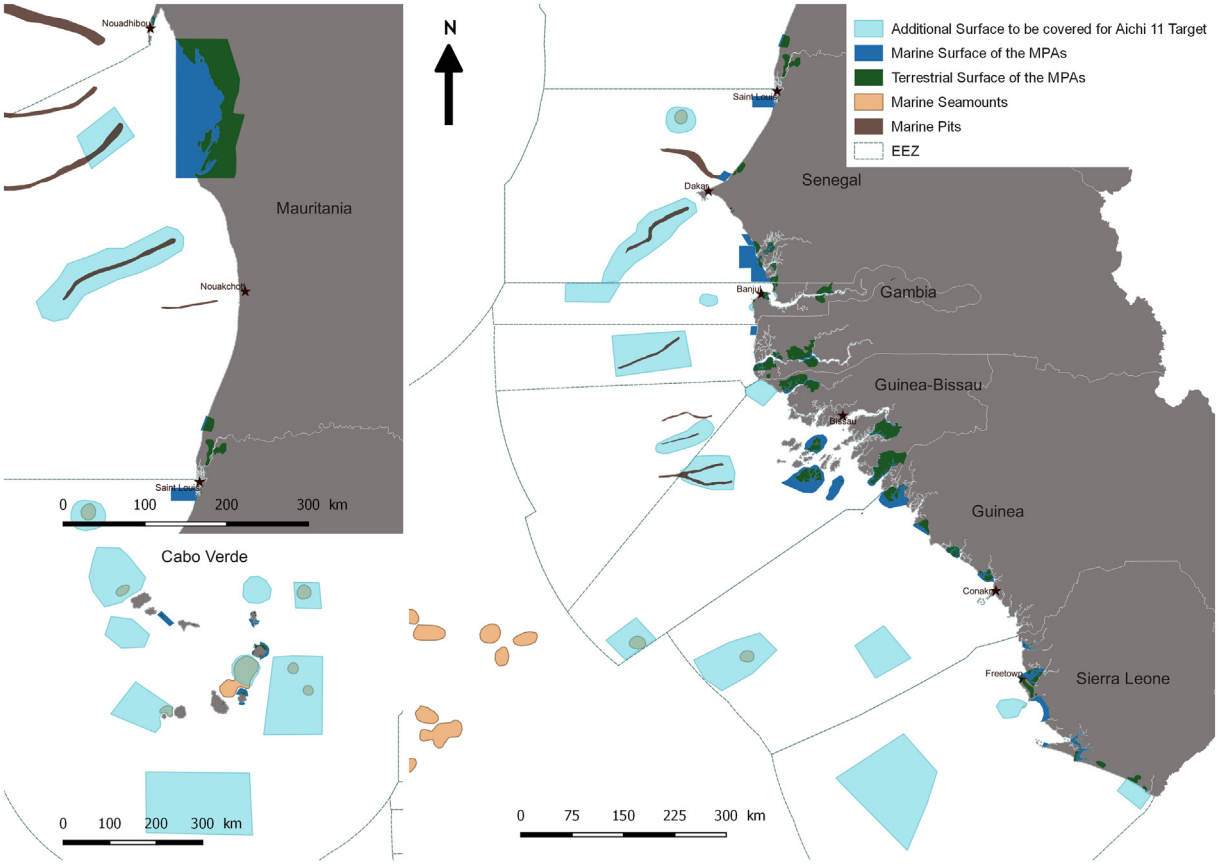

Fig. 5. Additional marine areas to be covered for each country towards Aichi Target 11. Note: by cumulating the existing and additional areas to be covered, each country reaches the 10% protected EEZ. The location and contour of the additional MPAs is free and virtual. These MPAs are usually arbitrarily placed in relation to seamounts and marine pits. Source for the bathymetry: https://www.gebco.net/data_and_products/gridded_bathymetry_data/.

both marine and terrestrial surfaces (Jenkins and Joppa, 2009).

- the reference coastline used by the WDPA to calculate the marine surface of MPAs is obsolete (2014 version of the *Flanders Marine Institute*, although there are more recent versions);
- Some UNESCO biosphere reserves[16] are counted in the marine protected area by mistake. Although the WDPA claims not to do that, some Biosphere Reserves may still have been counted in this database (Spalding et al., 2013), thus increasing national protected areas.[17]
- The MPAs who have multiple statuses can be counted as many times as they have statuses. For example, some MPAs in Guinea-Bissau are registered multiple times in the WDPA as "Natural Park", "National Park", "Hunting Reserve" or "Ramsar Site"[18];
- the land surface (islands, inextricable mangroves, coastline) can be mistakenly integrated into the protected marine surface (Spalding et al., 2013; Thomas et al., 2014);
- the outline of protected areas is sometimes inaccurate in the WDPA, as the Diawling National Park in Mauritania illustrates these gaps (Fig. 7). In addition, the areas announced for some MPAs may not necessarily be those that correspond to actual areas, although the contour represented in the WDPA is correct (Cros et al., 2014).

In this case, the counting of the Biosphere Reserve of the Bijagos Archipelago in Guinea-Bissau (even counted three times), as well as the double-counting of three other MPAs in Guinea-Bissau, are mainly responsible for the overestimation of the marine protected surfaces in the WDPA. In countries where surfaces are underestimated (Cabo Verde and Senegal), this is due to the large number of MPAs that are not registered in the WDPA.

Beyond technical errors in calculating MPA coverage, the use of the size of protected area as a metric of conservation should be scrutinised because it is not a sufficiently consistent indicator to measure the ecological progress of a country (Geldmann et al., 2015; Lemieux et al., 2019). The statutes and appellations underpinning the status of a protected area can vary among countries. These different statutes and appellations imply that the rules governing the principles of conservation do not have the same power of environmental protection inside the various protected areas. Some areas listed as MPAs are areas where the natural resource is managed locally; others have much more stringent legislation such as integral conservation areas. Taking into account the different levels of conservation and the quality management aspects of MPAs is thus essential. This should be in the foreground, along with the protected sea surface, currently the only indicator considered (Amengual and Alvarez-Berastegui, 2018; Rees et al., 2018; Woodley et al., 2012). In addition, the areas of partial restrictions (notably related to fishing) are not counted in the Marine

[16] Biosphere reserves are a UNESCO designation to highlight areas where ways of life coexist with the conservation objectives of an environment rich in biodiversity. Although this status brings great visibility, the level of constraint is too low to be considered a protected area per se. Especially since biosphere reserves are generally aggregations of already protected areas.

[17] This may be the case of Guinea-Bissau, which has a large biosphere reserve covering the Bijagos archipelago. In the WDPA, this Biosphere Reserve is even recorded three times (once as a "Biosphere Reserve", once as a "RAMSAR Site" and another time as a "UNESCO-MAB Biosphere Reserve"; see https://protectedplanet.net/search?country=Guinea-Bissau&main=country). Guinea-Bissau has 10% of marine protected area while in the data presented in this work, this protected area falls to around 2%.

[18] https://protectedplanet.net/search?country=Guinea-Bissau&main=country.

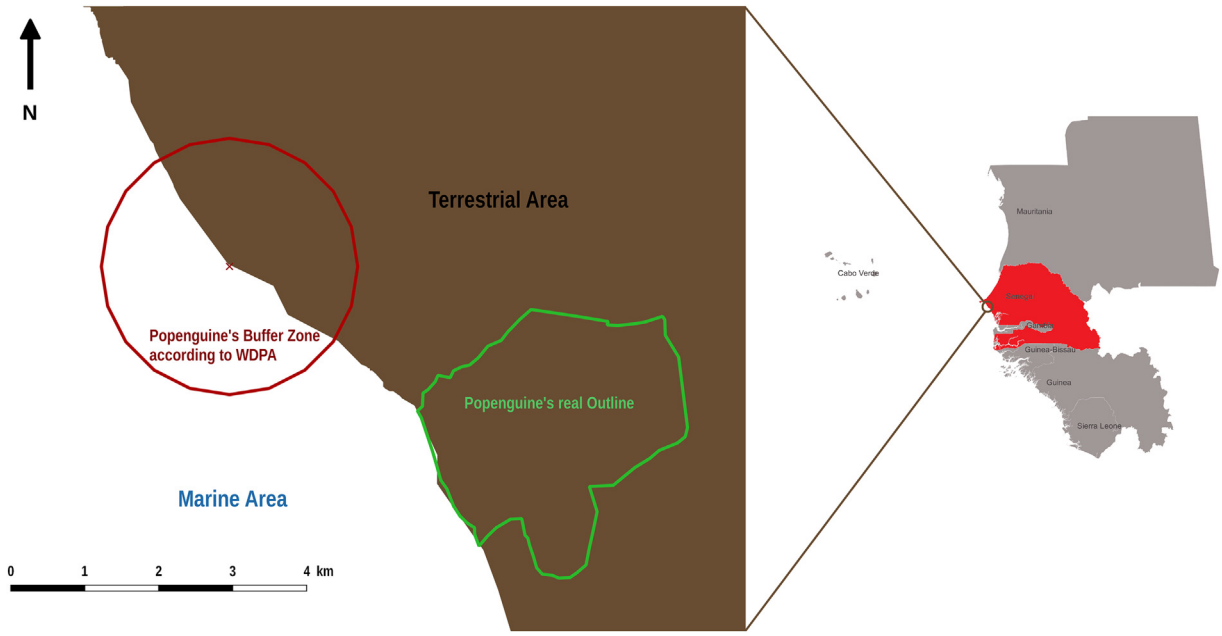

Fig. 6. Illustration of the difference of spatial coverage between the actual Popenguine Reserve's outline and a buffer zone of similar size made in the WDPA. Note: Thus, depending on the outline (real or buffer), the land cover of the protected area is very different and consequently the one of the marine area under protection. In addition, the location is slightly shifted in the WDPA.

Protected Areas Census of either the WDPA or the present census due to their lack of scope for the conservation of marine ecosystems (Mackinnon et al., 2015; Rodríguez-Rodríguez et al., 2016). Finally, protected areas should be representative to the diversity of natural habitats and ecosystems (Butchart et al., 2015; Naoe et al., 2015).

As pointed out by Cros et al. (2014) and Thomas et al. (2014), the process of MPA data acquisition can be improved. Data provided by the national administrations are often incomplete and approximate. Indeed, the WDPA then carries out, on its own initiative, a comprehensive action with information provided by international organizations (RAMSAR, UNESCO, IUCN). At the country level, the administrative complexity and lack of clarity in the process of transmitting information from the entities in charge of the MPAs[19] and the CBD focal points is a further cause of vagueness towards the WDPA; the lack of communication, together with any willingness to collaborate, is another explanation for the incompleteness of the WDPA database. The availability of information is reduced accordingly, leading to under-recognition of MPAs at the international level.

4.2. Performance and capacities of the countries

The seven countries included in this study are all behind in achieving Aichi's Target 11, regardless of the data used. The WDPA, the official reference, indicates that Guinea-Bissau has reached the 10% of protected marine surface, however, the information generated directly from national data in this study shows that the WDPA have overestimated the country's progress. The WDPA may therefore be a communication tool for some countries who have a high percentage of marine protected area surface like Guinea-Bissau and Mauritania to a lesser degree, but much less rewarding for others like Senegal and Guinea, for example, where progress towards achieving Target 11 is reduced.

From this study, even if no countries have achieved Aichi Target 11, Mauritania, Senegal and Guinea-Bissau are the ones most close to it. Mauritania created the emblematic MPA, the Banc d'Arguin, in 1976 whose international influence has had cascading positive effects on the region. In particular, the creation of the International Banc d'Arguin Foundation (FIBA) in 1986 to support conservation and monitoring activities and whose activities have progressively extended to the 6 other countries in the region[20] (Binet et al., 2013). The Banc d'Arguin National Park generates almost all Mauritanian marine coverage: large MPAs can be vectors of significant progress towards Aichi Target 11.

However, no MPA creation has been announced in recent years. Senegal, since the establishment in 2004 of a directorate dedicated to the management of MPAs (the DAMCP) has considerably strengthened its arsenal of protected areas. The success of Bamboung's community-based MPA has also given coastal communities environmental inclinations: several community heritage areas have been created in recent years (Kawawana and Kapac Olol for example), particularly in Casamance, where fisheries is an economic imperative for coastal and island populations. However, the almost widespread occupation of the coastline, outside of Casamance, limits the creation of new protected areas. The last of the three countries, Guinea-Bissau, has several large MPAs (even lower than Banc d'Arguin) following a dynamic initiated in the late 1980s, driven by IUCN. The creation in 2004 of the Institute for Biodiversity and Protected Areas gave consistency to the national program for the protection of the environment, particularly on the Bijagos archipelago, by reinforcing actions in favour of conservation and monitoring of areas closed to fishing. The current momentum in Guinea-Bissau is expected to be reflected in progress in protected marine coverage, extending, inter alia, the high seas protection areas around the islands of the Bijagos Archipelago.

At the regional level, efforts by international cooperation, national administrations and non-governmental organizations thus remain largely insufficient to achieve Aichi's Target 11. The setting up of programs and projects devoted to the protection of the marine and coastal environment,[21] by the creation of MPAs in particular, if it allowed a certain improvement of the existing one, did not allow a substantial increase of the surface of marine protected areas: <15% during the PRCM's period of existence, for example (see Fig. 8). Without doubt,

[19] Often housed in environmental or fisheries departments to which MPAs are often attached when there is no specific direction for protected areas.

[20] In 2009, the geographical expansion led to a change of name. The Foundation for Nature (MAVA) has taken over the activities of FIBA. Its action ends in 2022.

[21] Notably the most important of these: Coastal and Marine Regional Program of West Africa (PRCM) between 2000 and 2012. It became the Regional Partnership for Marine and Coastal Conservation after 2012.

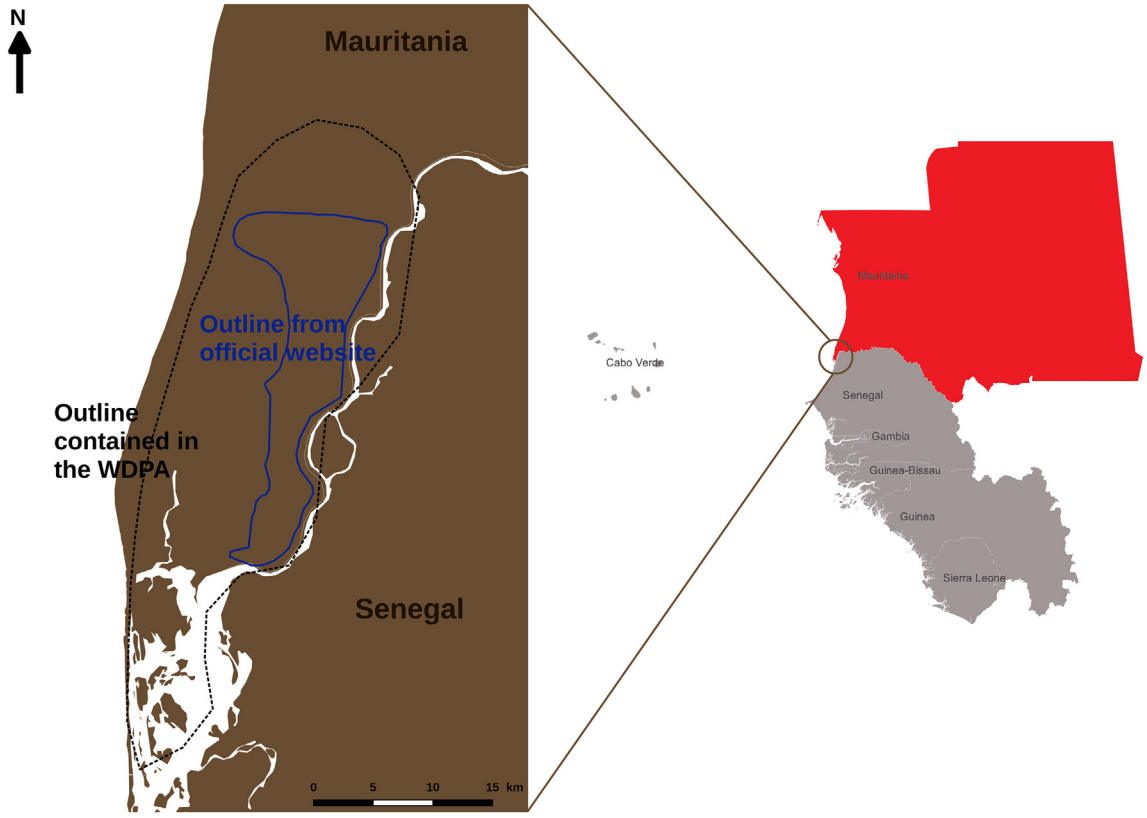

Fig. 7. Differences in the outlines: the case of Diawling National Park (Mauritania).
Note: The colour Map comes from Diawling National Park's Official Website (http://www.pnd.mr/pnd/index.php?option=com_gismap); WDPA Ouline: https://protectedplanet.net/diawling-national-park.

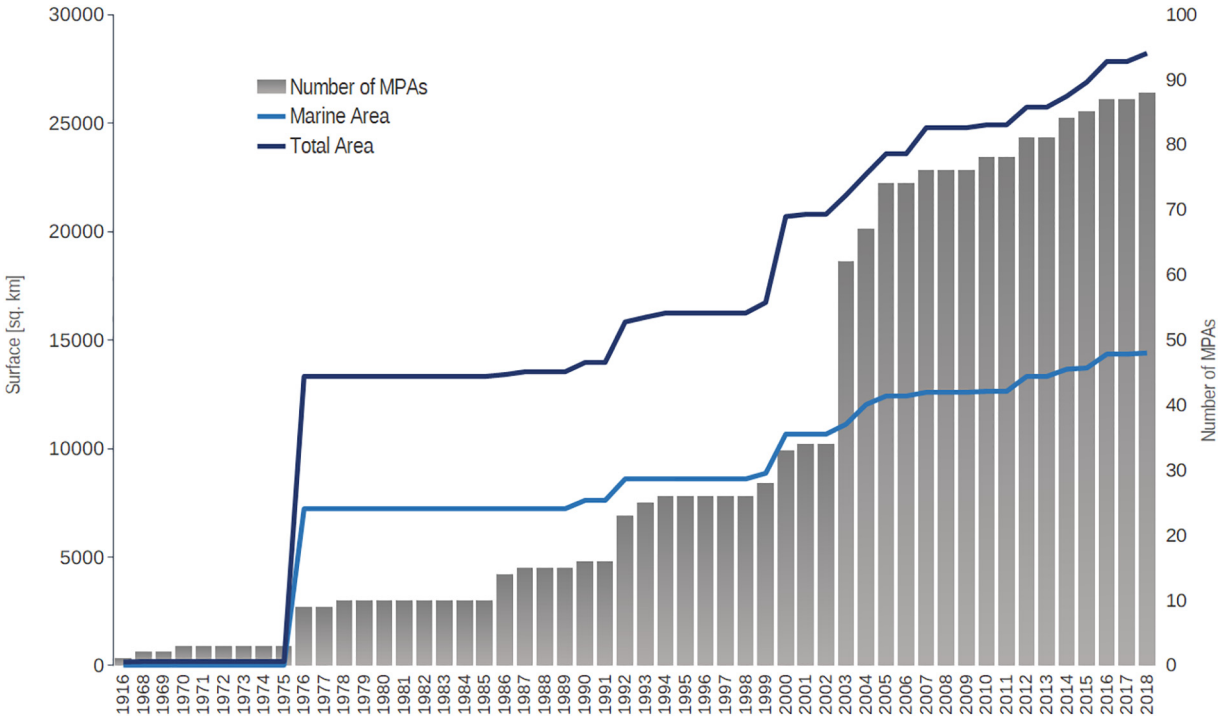

Fig. 8. Evolution of the total area of MPAs: marine (light blue) and terrestrial (dark blue) in sq. km in West Africa over the years. The columns illustrate the number of implemented MPAs (axis in the right). Note: Year 2003 corresponds to the beginning Marine and Coastal Program in West Africa (PRCM). From 2012, the PRCM becomes the Marine and Coastal Partnership. In 1916, the Western Area Game Reserve (Sierra Leone) was created, in 1968 the Abuko Reserve (Gambia) and in 1976 the Banc d'arguin National Park (Mauritania). Most Cabo Verde MPAs are recognized in 2003. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Source: Own elaboration.

the lack of use of a referent for each country has resulted in a half-hearted performance: the important thing has not been the area under protection but the number of MPAs created, considered as an indicator of the performance of the work carried out.[22]

The region is also weak in organizing and coordinating conservation efforts (Sène, 2013; UICN/PAPACO, 2009). Human and institutional capacities as well as financial means are limited (UNDP/Go-Wamer and WWF, 2014). This leads to institutional fraying where managers and conservators have very little means of intervention in the field (Failler and Kane, 2003; Ferraro et al., 2011); of which the decentralization process initiated in the 1990s has not counteracted, leading to suboptimal management of MPAs (UICN/PAPACO, 2012).

4.3. Large offshore MPAs to meet Aichi Target 11

Considering the gap between the protected marine cover and Aichi Target 11, it is imperative that countries in the region develop consistent conservation strategies. Actual MPAs are generally under-sized to achieve the 10% target of the protected EEZ. In addition, MPAs are confined to the littoral, estuaries and lagoons. Although the shoreline is an extremely important area to conserve (Meinesz and Blanfuné, 2015), it is essential to develop large offshore MPAs in order to ensure the achievement of the Aichi Target 11 and to complete the range of existing MPAs. Since it is inconceivable to protect the entire coastline of West African countries with a cordon of MPAs, setting up large-scale offshore MPAs seems the only solution to reach the 10% coverage of the EEZ.

Despite the CBD's imperatives, the countries of the region are likely to be reluctant to set up high sea MPAs. The offshore marine area is indeed the subject of intense fishing activities (Seto, 2015) and, soon, oil and gas exploitation (Gueye et al., 2017). On one hand, fishing organizations, especially artisanal ones, are powerful enough to intervene in such projects (Sall, 2007). On the other hand, the countries may wish to preserve their fishing advantages and their attractiveness for foreign fishing, under bilateral fisheries agreements or concessions of free licenses, which can represent up to 15% of the national budget of some countries such as Guinea Bissau (Failler, 2015). In this context, the establishment of large offshore MPAs would conflict with the commercial activities that underpin the development of nations in economic take-off (Maestro et al., 2019; Marinesque et al., 2012).

In such a context, RAMPAO can stimulate a regional policy on MPAs by highlighting their role in maintaining biodiversity and mitigating climate change through the persistence of the resilience capacities of protected ecosystems (Bonnin et al., 2015). Thus, MPAs would be an integral part of the National Determined Voluntary Contributions whose implementation will begin at the end of 2018. These contributions lack of consideration, as well as the marine environment as a whole, in their formulation for the COP21 in November 2015 in Paris, which shows the lack of articulation between policies specific to climate change and the conservation of coastal and marine ecosystems. Without replacing national administrations, RAMPAO can thus facilitate the creation and implementation of MPAs through logistical, human and financial support (Horigue et al., 2014; Van Lavieren and Klaus, 2013).

Such a network like RAMPAO may also offer an important communication tool for all MPAs in the region whose recognition is generally limited to a very local scale (Failler et al., 2018). This role of relation facilitator can, in addition, be strengthened by gathering existing data and information, their validation and dissemination, to the attention of national and international public decision-makers as well as to the WDPA.

5. Conclusion

For the first time, MPAs in the West African region have been comprehensively and accurately recorded. The dataset, some of which have never been published before, provides information on the protected coverage of the marine space of the seven countries of the region and allows for measurement of the gap between what is recorded in the WDPA and what is officially recognized in the scale of the seven countries of the West African region. There were substantial differences between the comprehensive survey and WDPA database in the number of MPAs recorded (88 vs 54 respectively) and their total area (28,294m^2 including 14,447m^2 of actual marine surface vs 20,382 km^2 all of which is marine respectively). It also shows that the progress of West African countries towards Aichi Target 11 is overestimated for some countries (Mauritania and The Gambia), or even significantly overestimated as for Guinea Bissau which according to the WDPA has reached Aichi Target 11 while the marine protected cover is, in fact, only 2.2%. It is, on the contrary, underestimated for others: Senegal, Cabo Verde, Guinea and Sierra Leone.

This information can be used to improve data recording of MPAs. At the scale of the West African Region, the WPDA provides an overestimation of marine protected surface of almost 30%. The main source of error comes from the lack of clarity in the statutes of some MPAs resulting in repeated counting and duplication of data. As data are furnished by national institutions to the WDPA, both sides have to be more careful about the statutes, so new data are not added to the previous ones. In addition, some MPAs whose statutes are not consistent enough to be included in the WDPA (proposed MPAs, UNESCO Biosphere Reserve) should be excluded. Furthermore, as many MPAs have obsolete outlines or none in the WDPA, a particular effort should be made by countries to provide details. Overall, consistency between what countries record and what is in the WPDA should be sought for based on a regular monitoring from countries.

It appears the seven countries studied are not on course to reach the target of the 10% EEZ covered by protected areas by 2020. To meet the target will need adopting a new MPA implementation strategy with a focus on the significant increase in protected marine cover (Thorpe et al., 2011). Since most of the existing MPAs are located along the coastal and insular shoreline and, with rare exceptions, occupy areas of modest size and undevelopable due to the strong spatial anthropization, the creation of large offshore MPAs are the only viable solution to reach Aichi's Target 11. Many obstacles to the deployment of such a strategy exist, however, mainly because of the occupation of offshore areas for fishing and, in the coming years, for the exploitation of hydrocarbons. However, issues specific to sustainable development and the fight against the effects of climate change instil the precepts of conservation of which MPAs are a central element.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[22] PRCM forum reports never mention the increase in area. In addition, more than twenty MPAs have been created since 2003 and the establishment of the PRCM but only 5 MPAs exceed the size of 500km^2. In addition, there are only 2 MPAs created since 2003 that have an area >1000 km^2 (Tristao in Guinea with 1013km^2 but a RAMSAR area had already been present at the same place since 1992, and Cantanhez in Guinea-Bissau with 1225 km^2).

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Appendix A. Supplementary data

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