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The Poorly Known Northeast Atlantic Regional Management Unit for Loggerhead (*Caretta caretta*)

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Abstract

Loggerheads are distributed by ten Regional Management Units (RMUs) worldwide. The Atlantic Ocean houses three of these: the Northwest, Southwest and Northeast RMUs. The most studied is, so far, the Northwest RMU, but the other two have focused attention of researchers. In contrast, marine turtles from the African Atlantic region (Southeast) belong to a complex but little-known region. What is their role in the Atlantic? Are these RMUs connected? To understand these questions, research was made of reports and publications concerning the Northeast Atlantic (NEA) RMU. The asymmetry in information and available knowledge about NEA is high when compared to other RMUs. This demonstrates that there is still a lack of conservation programs besides Cape Verde, and that there is difficulty in transforming data (nesting ecology, molecular, telemetry, etc.) into publications. However, this issue is evident for other marine turtle species of East African Atlantic. There is a need for better scientific support, to enable local conservation programs to deliver data in reports, and even scientific publications. There are so many aspects of loggerhead's life cycle that will only be unravelled by more and better supported studies. This is a paper that, by analysing the available information of the NEA loggerhead RMU, reflects the following steps to address in loggerhead conservation for the African Atlantic coast.

Keywords

Loggerhead, *Caretta caretta*, Regional Management Units, African Atlantic Region

1. Introduction

Sea turtles, important ecosystem species, have been a matter of concern for nu-

merous sectors, such as: scientists [1] [2] [3], the economic industry, society, and governments, due to their decreasing populations [4] [5].

There are ten distinct RMUs established for the loggerhead (*Caretta caretta*) and only three of them are in the Atlantic: Northwest, Southwest, and Northeast [6] [7] (**Figure 1**). There is no Southeast RMU [6] [7], even though this species is known to forage in these waters [8].

The evidence shows a high contrast in expertise and conservation efforts in different parts of the globe. In the African Atlantic region, according to West Africa Biodiversity and Climate Change Program, there are still "insufficient and unconsolidated data at local, national and regional levels" [9]. This report emphasizes the urgency of addressing new knowledge at regional level to support priority measures and develop key elements to improve marine turtle's conservation. This is a particularly important aspect because there appears to exist an increase in (direct and indirect) threats that hinder their survival and conservation [9].

The low amount of data available on the African coast is a real problem for conservation [10] and therefore it is essential to report consolidated data and ecology indicators to understand the real context of each population.

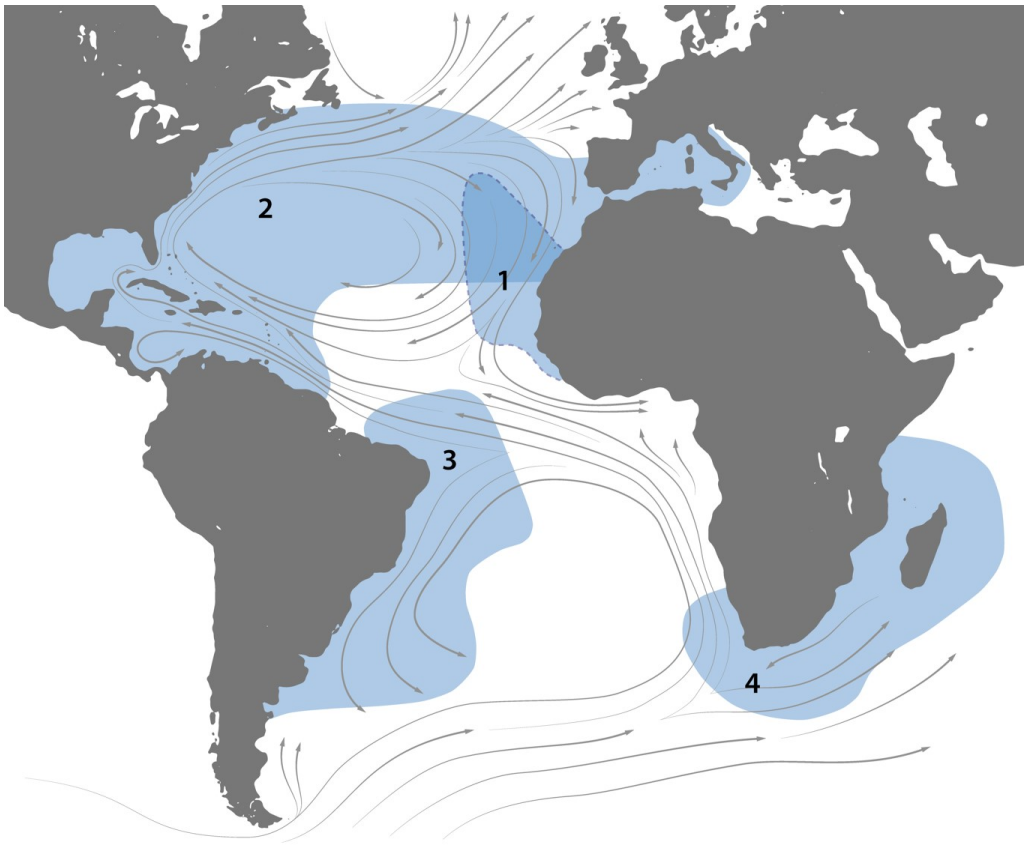

Figure 1. Loggerhead Atlantic RMUs. 1—Northeast Atlantic Regional Management Unit (NEA RMU); 2—Northwest Atlantic Regional Management Unit (NWA RMU); 3—Southwest Atlantic Regional Management Unit (SWA RMU); 4—Southwest Indian Regional Management Unit (SWI RMU). (Adapted from Wallace *et al*., 2010 [7]. Credits: Cardoso, S.).

2. Atlantic Regional Management Units

2.1. NEA, a Loggerhead RMU

Cape Verde is the most important nesting site for loggerhead in the NEA RMU [6] [9] [11], being the second most important in the Atlantic region and the third worldwide, behind the Florida and Oman aggregations [6] [9]. Nevertheless, the rest of the coast plays a very important role in its life cycle as it is a migration path and a temporary residence area for them [12], with females that nest in Cape Verde [7] being sighted along the African coast towards the south [13].

Researchers know that loggerhead population (mainly juveniles) in the Canary Islands are estimated to be several hundred, and large numbers can be seen on their migratory journey across the area [6] [13]. In the Marine Turtles Specialist Group Regional Report 2020 [14], *C. caretta* presence is reported in Morocco (threaten by bycatch but with no references to nesting on its beaches), Mauritania (feeding grounds found in the north of coastal waters, and in Banc d'Arguin National Park coast), Guiné-Bissau (though its presence is rare, but investigators are considering it to be an extension of the NEA RMU for this species), Sierra Leone (with loggerhead nesting from the NEA RMU), Liberia (with references to loggerhead in their data, though scarce), Ghana (with loggerhead nesting females, though extremely rare), Togo (rarely seen), and Cameroon (sporadically seen feeding). However, the information is scarce and poorly consolidated. Furthermore, no loggerhead was reported in Côte Ivoire, Benin, Equatorial Guinea, Gabon, Congo, Angola, and Namibia [14], which contrasts with the Atlantic Southwest RMU where *C. caretta* is stablished at the same latitudes, but on the other side of the ocean [7], for 2005, on the other hand, Weir *et al.* [15] reports the presence of the species offshore and as coastal bycatch, in Angola. This study, carried out between 2000 and 2006, also highlights the unclear status of the loggerhead and the lack of knowledge about nesting behaviour in this country. Although the decline of the *C. caretta* populations has been accentuated over the years, further studies are needed to understand the current migratory behaviour and to clarify the changes in its geographical dispersion, as suggested in the literature.

Vieira *et al.* [16] reports loggerheads in São Tomé and Príncipe (see data tables in the report). However, as a consequence of scarce field work or due to the absence of this species, the lack of information does not allow to clarify if these individuals belong to de NEA RMU or to the Indian Southwest RMU [7].

Considering the (lack of) bibliography, some questions arise: are the NEA loggerheads migrating south through the African Atlantic coast? And if so, which are the suitable feeding territories? May these territories be used for nesting in the future? Is this being influenced by human pressure on coastal territories at their current nesting places?

2.2. RMUs Interconnectivity

Marine turtles from the African Atlantic region belong to a complex but lit-

tle-known region. Authors have been emphasizing this [14] [17] [18], as much information is yet to be gathered. Even though one could think NEA loggerhead population would be more isolated, that may be not the case. Results shown by telemetry studies demonstrate the tendency of some turtles to migrate to southern areas from the NEA RMU, after nesting in Cape Verde beaches [8]. Tracked turtles followed by Hawkes *et al.* [8] moved from Cape Verde to the coast of Guinea, Sierra Leone, Mauritania, Senegal, Gambia, and Guinea Bissau. New telemetry studies would improve our knowledge about these routes and destination, as well as range and foraging behaviour may be easily elucidated due to satellite tracking [8].

Additionally, studies using genetic markers identified NEA RMU turtles haplotypes found in the Southeast US [19], meaning they cross the ocean basin using, potentially, the North Atlantic gyre [20] [21]. Similar migratory patterns exist in the Pacific [19], with loggerhead juveniles migrating from Australia to Peru [19] [22] using the South Pacific gyre [23]. In fact, longer distances are covered by loggerhead sea turtles, although not as long as those travelled by leatherback and green turtles [24]. This information supports trans-oceanic migrations for *C. caretta*, and these patterns probably occur in all oceans in which they are present [19].

According to data from recapture of tagged turtles and genetic markers, some individuals even enter the Western Mediterranean [12] via the Azores, Madeira and Canary Islands after traveling from Northwest Atlantic during their developmental migration [19], hence, connecting three different RMUs: Northwest Atlantic, Northeast Atlantic and Mediterranean.

However, the interconnectivity between RMUs is still not clear enough. This concept was established to create multi-scale information about sea turtles around the world using the existing information on marine turtle biogeography [7], being the most considered parameter the nesting of females (see table 1 in Wallace *et al.* [7]) due to the lack of information on other parameters, such as telemetry data.

Sea turtles are migratory animals that travel between feeding and breeding areas and occupy different places during their life cycle. Hence, knowing the developmental and feeding sites and the migration paths is decisive to achieve an effective long-term protection of the loggerhead, and all their life cycle habitats. The fact that some females nest in Cape Verde and then migrate to the African Atlantic coast is an example that accentuates the importance that improving knowledge of migratory routes has for the conservation. During this journey, they are subjected to threats such as bycatch and plastic pollution, emphasizing the need of an international cooperation in order to achieve a successful result [8].

2.3. What Is Missing?

Despite national laws and active conservation projects, marine turtles remain

under threats, both at the nesting sites and the other habitats they occupy [6]. For example, once in the ocean, the bycatch is one of the biggest anthropogenic threats to turtles and other marine animals [8] [25] [26] [27] and measures such as turtle excluder devices (TEDs), and circular hooks in longline fisheries [1] must come into force. In particularly, there has been an expressive input of individuals due to Cape Verdean Conservation projects that attempt to mitigate the threats through the implementation of regional actions. These projects have shown good results and can make a difference in the recovery of this marine turtle population, as noticed by Hays [28] for other marine turtle populations.

However, the NEA RMU is one of the 11 most threatened marine turtle populations in the world [29] [30]. Probably, the lack of scientific intervention leads to little knowledge and may lead to threats. The data gap is more evident in the African coast, when compared to other areas, like the Atlantic Northwest [31]. Despite the "Memorandum of Understanding Concerning Conservation for Marine Turtles of the Atlantic Coast of Africa" signed in 1999, which resulted in the creation of several regional programs along the coast [32], no substantial or fully successful efforts have been made to strengthen sea turtle conservation along this shore [33]. Therefore, it is imperative that studies are carried out to know the potential interest of conservation along the NEA African coast, providing solid ecological indicators for the NEA RMU. In this way, knowledge gaps can be filled, highlighting the role of research in the implementation of conservation measures in this area.

Throughout the last decades, some measures, such as the protection of nesting females in the beaches, have shown results [28], while others haven't been proven as providing a meaningful contribution to the increase of populations. Knowing what is affecting the status of a population is the first step to apply the correct mitigation measures.

3. Conclusions

This work provided an opportunity to reflect about African RMUs, the lack of information about loggerhead on the Atlantic coast and the consequences that this had on its conservation.

It is urgent to learn more about the species biogeography in order to create measures to safeguard not only sea turtles, but also the biodiversity that surrounds it [6]. Despite the several warnings about the importance of studying the African coast, we must reinforce this need. Namely, for loggerhead turtles in the African Atlantic region, further data on migration, territorial occupation (pelagic, neritic, and nesting sites), and threats are fundamental. Once we have more solid information about these issues, it will be possible to apply measures to protect these individuals, not only on the nesting beaches, but also in the other habitats they occupy.

The conservation of sea turtles must go far beyond measures focused exclusively on these species. Developing effective sea turtle conservation methods re-

quires a thorough knowledge of both sea turtle biology and the human social and economic condition [1] [6]. Placing economic interests over conservation, in long term, will be more expensive. Biodiversity is the basis for the socio-economic activities that provide well-being. Not paying attention to this knowledge is already affecting our living conditions. This does not mean that we must deprive ourselves of the total use of biodiversity; instead, it is a beacon to remind us that we need to manage biodiversity in a more sustainable way.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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