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The leatherback turtle *Dermochelys coriacea* (Vandelli, 1761) in the Bay of Biscay and the North East Atlantic

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ABSTRACT

This paper is a synthesis of our knowledge on the leatherback turtle *Dermochelys coriacea* (Vandelli 1761) in the Bay of Biscay and in the North East Atlantic. Numerous sightings in these two regions lead us to believe that they are foraging areas for this critically endangered (CR) species (IUCN, 2011). Its conservation does not depend solely and exclusively on mitigating the anthropogenic interactions, but also in the protection and use of its habitat. For this reason we will highlight the importance that Marine Protected Areas (MPA) could have and the need for new areas to be declared along the European Community coastline and within the vast bodies of water of the Bay of Biscay and the North East Atlantic.

KEY WORDS: *Dermochelys coriacea,* leatherback turtle, conservation, Bay of Biscay, North East Atlantic.

RESUMEN

En este artículo pretendemos exponer el conocimiento que se tiene sobre la tortuga laúd *Dermochelys coriacea* (Vandelli, 1761) en el golfo de Bizkaia. Existen zonas en el golfo de Bizkaia y el Atlántico Noreste de gran utilidad para *D. coriacea,* que se pueden definir como zonas de alimentación para la especie en peligro crítico de extinción (CR) (IUCN, 2011). La conservación de la especie no depende única y exclusivamente de la mitigación de las interacciones entre la especie y las actividades antropogénicas directas con ésta sino también con los hábitats y el uso que hagamos de los mismos. Por todo ello, queremos subrayar la importancia que pueden tener las Áreas Marinas Protegidas y la necesidad de que se declaren nuevas zonas en nuestras costas y aguas comunitarias europeas.

PALABRAS CLAVE: *Dermochelys coriacea,* tortuga laúd, conservación, golfo de Bizkaia, Atlántico Noreste.

LABURPENA

Lan honen bitartez, Bizkaiko golkoan larruzko dortoka *Dermochelys coriacea-z* (Vandelli, 1761) ezagutzen dena aurkeztu nahi izan dugu. Bizkaiko golkoan eta Atlantiar Ipar Ekialdean *D. coriacea*-rentzat garrantzi berezia duten guneak aurkitzen dira, desagertzeko arriskuan katalogatua dagoen (CR) (IUCN, 2011) espezie honentzat elikadura gune bezala definitu daitezkeenak. Giza jarduera batzuek espeziearekiko interakzio zuzena badute ere, hauen murriztea edo ekiditzea ez da kontserbaziorako eman beharreko pauso bakarra hain zuzen ere beste jarduera batzuek habitatetan dituzten ondorioak eta berauen erabilerak ere kontuan hartu beharrekoak dira. Guzti hau dela eta Itsas Eremu Babestuek duten garrantzia azpimarratu nahi dugu bai gure kostaldean baita europar batasuneko uretan ere.

GAKO-HITZAK: *Dermochelys coriacea,* larruzko dortoka, kontserbazioa, Bizkaiko golkoa, Atlantiar Ipar Ekialdea.

INTRODUCTION

Sea turtles are species, which are not well-known in the Bay of Biscay and the North East Atlantic. Of the seven species existing in the world, the loggerhead sea turtle *Caretta caretta* (Linnaeus, 1758) and the leatherback turtle *Dermochelys coriacea* (Vandelli, 1761) are the most cited in these areas (Brongersma, 1972; Duguy, 1997; Camiñas, 2004; Cermeño *et al.,* 2006). The former belongs to the Cheloniidae family, which includes a further five species; the latter is the sole survivor of the Dermocheliidae family.

The first mention of *D. coriacea* in the Basque Country was published in 1951, and refers to a specimen captured by a bonito fishing boat in Mutriku (Navaz & Gómez de Llanera 1951). Like the other species of sea turtle, *D. coriacea* has experienced a drastic reduction in many of its populations over the last few decades (Sarti Martínez, 2000 in IUCN, 2011). For this reason, it is currently protected and classified on the International Union for Conservation of Nature (IUCN) Red List. Although an increase in its populations in recent decades as been observed in the Atlantic, mainly in the Caribbean region (Dutton *et al.*, 2005), and its numbers have stabilized in others, its "critically endangered (CR)" classification assigned by the IUCN (Sarti Martínez, 2000 in IUCN 2011) has not been modified. In Spain, this species is included on the red list of threatened species (Camiñas, 2004). The cataloguing and protection of these reptiles in the waters of the Basque Country but also in other communities along the Cantabrian coast are still pending.

DISTRIBUTION AND ABUNDANCE OF THE LEATHERBACK SEA TURTLE IN THE BAY OF BISCAY AND THE NORTH EAST ATLANTIC

Observation of *D. coriacea* adult individuals in the North East Atlantic, including the Bay of Biscay, is relatively frequent, although published data are scarce. According to a compilation of surveys on sea turtles in Galicia and the Cantabrian coast, 518 individuals of five different species

were spotted between 1990 and 2005 (CERMEÑO *et al.*, 2006). In this study, *D. coriacea* was the second most commonly-sighted species (40.7 %), after *C. caretta* (55%).

The seasonal pattern of the species in this region was identified by DUGUY (1997) and confirmed by MARTIN (2003). According to these authors, *D. coriacea* visits the Bay of Biscay during the summer (DUGUY, 1997; MARTIN, 2003; WITT *et al.,* 2007a). Tracking of individuals have shown that turtles migrate from areas of reproduction in the Western Atlantic (Caribbean, French Guiana) to the North Atlantic using northern branches of the Gulf Stream or North Atlantic Current (HAYS *et al.*, 2004, 2006; ECKERT, 2006; DOYLE, 2007). These ocean frontal regions are known to be highly productive areas and where leatherbacks are known to forage along with a great variety of marine fauna and the resulting fishing fleets (FERRAROLI *et al.,* 2004).

The presence of Leatherbacks is clearly greater on the Galician coast than on the Cantabrian coast, dropping sharply as one travels eastwards. This is probably due to its closer proximity to the North Atlantic Current and to the presence of major foraging areas such as the Galicia Bank.

The male specimens of *D. coriacea* tend to be mainly adult individuals, and on the Cantabrian coast their average size (Curved Carapace Length, CCL) is 161.5 cm (n=74) (CERMEÑO *et al.*, 2006), which is within the range of the sizes of reproducing females among the Atlantic population (CHACÓN-CHAVERRI, 1999; STEWART *et al.,* 2007).

Other studies take other major foraging areas into consideration in the North Atlantic, such as Nova Scotia (Canada) (JAMES *et al.*, 2005, 2006a, 2007) or the waters north of the Bay of Biscay such as the Irish and Celtic Sea (HAYS *et al.,* 2004, 2006; HOUGHTON *et al.,* 2006; WITT *et al.,* 2007a; FOSSETTE *et al.,* 2010). During the summer, when primary production decreases in the ocean, the continental slope of the Celtic Sea becomes a major area for the production of plankton (GARCIA-SOTO & PINGREE, 1998). The tidal front of the Irish Sea (PINGREE & GRIFFITHS, 1978) is also a significant area for summer plankton production.

The 15 °C isotherm has been described as the northern distribution limit for this species in waters of the North Atlantic, although it may withstand lower temperatures (MCMAHON & HAYS, 2006; JAMES *et al.,* 2006b). Other authors (WITT *et al.,* 2007a) postulate isotherms of 10-12 °C.

A clear choice of habitat on the part of *D. coriacea* has been observed when the abundance of gelatinous organisms increases at the end of summer and early autumn (WITT *et al.,* 2007a). The correlation existing between *D. coriacea* and its prey (mainly gelatinous plankton organisms) has been proven on different occasions in the North Atlantic, both in Canadian waters (JAMES & HERMAN, 2001) and in Irish Sea waters (HOUGHTON *et al.,* 2006; DOYLE, 2007; FOSSETTE *et al.,* 2010) although the effects of environmental conditions on the abundance of prey and predatory behaviour are still unknown (SHERRILL-MIX *et al.,* 2007).

Observation of *D. coriacea* in the North-East Atlantic tends to be concentrated in the summertime (DUGUY, 1997; MARTIN, 2003; PENROSE & GANDER, 2010). In the case of the Cantabrian coast, there is no established coordinated network of strandings or sightings to help put together information and develop relevant regional coastal reports, as it is the case for the British Isles and France (WITT *et al.,* 2007b; PENROSE & GANDER, 2010; DELL´AMICO & MORINIÈRE, 2010) or in the Mediterranean (e.g.: TOMÁS *et al.,* 2008; CASALE *et al.,* 2010).

Leatherbacks have been sighted off La Rochelle (Dell´Amico & Morinière, pers. comm.), where there is evidence of abundant jellyfish (SEBASTIAN *et al.,* 2011), as well as a large number of *D. coriacea* strandings. The French coast is characterized by a major fluvial contribution (e.g. Gironde River) and the presence of tidal fronts (PINGREE *et al.,* 1982), which during the summer increase biological production. The departments of Charente-Maritime and Vendée on the French Atlantic Coast are the areas where this species would seem to be most abundant, both in terms of sighted and stranded specimens (DELL´AMICO & MORINIÈRE, 2010). This fact is explained by local productive processes, which include – among others – the vertical mixture of the continental slope waters and the topographic effects of the banks. Figure 1 shows concentrations of plankton in the mouth of the Gironde, the Cantabrian outcrop and ocean whirlpool region. The concentration of plankton on these structures is greater as one travels further away from the interior of the Bay of Biscay (GARCIA-SOTO *et al.,* 2002).

In a study of *D. coriacea* migratory behaviour using satellite tagging in the North East Atlantic (DOYLE *et al.,* 2007b), an individual increased the time it remained in one of these ocean structures for several months, validating their good foraging conditions. This behaviour has been observed by other authors and in other species of sea turtle, thereby confirming that whirlpools and eddies are associated with a great abundance of prey (SHOOP & KENNEY, 1992; LUTCAVAGE, 1996; LUSCHI *et al.,* 2003; FERRAROLI *et al.,* 2004; HAYS *et al.,* 2006; ECKERT, 2006; POLOVINA *et al.,* 2006). The presence of swoddies or Slope

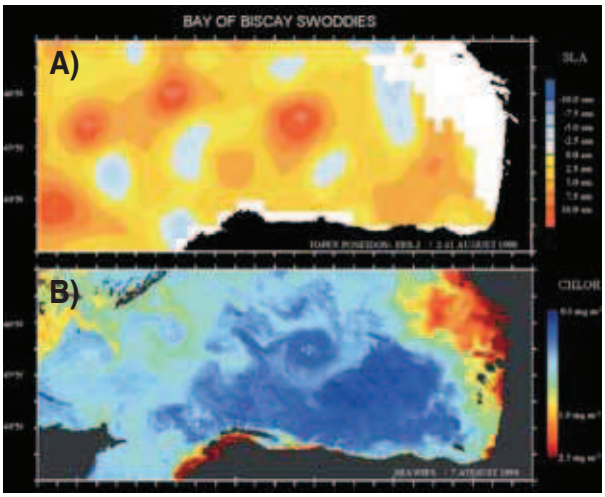

Fig. 1.- *Swoddies* in the Bay of Biscay in August 1998. (A) Sea level (cm) and (B) Concentration of phytoplankton (mg Chlorophyll/m^3). (GARCIA-SOTO *et al.,* 2002).

Water Oceanic Eddies common in the south of the Bay of Biscay (Garcia-Soto *et al.,* 2002) could explain the increase presence of sea turtles in the area in the summertime.

ANTHROPOGENIC IMPACTS

Traditionally, the main causes of decline of sea turtle populations, has been the loss of nesting beaches and other threats that affect reproduction (Lutcavage *et al.,* 1997). Bycatch during fishing manoeuvres (Duguy *et al.,* 1998; Lewison *et al.,* 2004a, 2004b; Lewison & Crowder, 2007; Peckham *et al.,* 2007; Báez *et al.,* 2007 and 2008; Wallace *et al.,* 2008), climate change (Poloczanska *et al.,* 2009), the loss of habitat both in egg-laying areas and on the open sea (Lutz & Musick, 1997; Bolten & Witherington, 2003) and sea pollution due to heavy metals and solid residues (Duguy *et al.,* 1998; Mrosovsky *et al.,* 2009) are factors responsible for the decline in populations worldwide.

In the specific case of *D. coriacea*, mortality factors identified on the French Atlantic coast have been the ingestion of plastics, collision with vessels and bycatch by fisheries (Duguy, 1997; Duguy *et al.,* 1998). On the Basque coast and the rest of the Cantabrian coast, although specific studies are inexistent, similar causes of occasional stranding are most likely to be blamed.

Fishing and bycatch

There is a wide range of examples in the literature regarding bycatch of marine megafauna by different fisheries worldwide: dolphins in purse seine nets caught by tuna fishing boats, albatrosses caught by longline fishing and sea turtles caught by shrimp trawling, or by surface longline fishing (Silvani *et al.,* 1999; Hall *et al.,* 2000; Lewison *et al.,* 2004a; Lewison & Crowder, 2007; Báez *et al.,* 2007 and 2008; MRAG Ltd, 2008).

Although it is quite well documented that large-scale industrial fishing has given rise to a drop in sea turtle populations, not enough attention has been paid to the impact of small-scale fisheries on non-target populations of these species. The great majority (99 %) of the 51 million fishermen in the world fish in coastal waters (within 12 miles), not surprisingly these coastal habitats are also frequented by numerous migratory marine species with a high potential for bycatch. As a result of this overlap, fisheries may constitute one of the greatest threats to endangered species (Peckham *et al.,* 2007). Artisanal fisheries would seem as a whole to be responsible for bycatch on a major scale. This decreases the effectiveness of the means for reducing bycatch which is being put into practice by industrial fisheries worldwide (Peckham *et al.,* 2007; Alfaro-Shigueto *et al.,* 2008; Alfaro-Shigueto *et al.,* 2010). Proposals to reduce bycatch would benefit from studies quantifying the bycatch by small-scale fisheries and the impact on habitat of endangered species (Soycan *et al.,* 2008).

There are large gaps in our knowledge about bycatch and closer monitoring of this is needed, particularly in less studied regions (Carreras *et al.,* 2004; Lewison *et al.,* 2004b; Tomás *et al.,* 2008; Wallace *et al.,* 2010; Álvarez de Quevedo *et al.,* 2010). The most recent report by the study group on the bycatch of protected species by the International Council for the Exploration of the Sea (ICES, 2008), refers to the lack of funding for onboard observer programmes and reflects the scant attention paid to bycatch of protected species manifested by most member countries.

A survey conducted systematically with fishermen was carried out for the first time in the Basque Country in 2010 (Zaldua-Mendizabal, 2010) to assess possible interaction between coastal fisheries (47 coastal vessels polled out of a total of 193) and sea turtles in waters of the Bay of Biscay. From the data obtained about bycatch, which referred exclusively to *C. caretta*, and the distribution of the fishing effort during 2009, a Catch per Unit Effort value (CPUE) was obtained of 0.0018 turtles/month/vessel. It should be pointed out that vessels were not boarded and therefore the CPUE values obtained from the survey could not be validated (Zaldua-Mendizabal, 2010). The distribution and summer seasonal presence of *D. coriacea* in the area were also confirmed in during this study (Fig. 2). Furthermore, the existence of hot points of great importance for conservation of this species in the Bay of Biscay and adjacent areas of the North East Atlantic were also identified.

The conclusion drawn from the assessment work carried out on the bycatch of sea turtles by the Basque coastal fishing fleet shows that the density of turtles in waters near the coast is low, which means interaction with fishing fleets operating in these waters would appear to be limited and does not entail a potential threat to stocks in the Bay of Biscay (Table 1). Conversely, the survey reflected a greater density of sea turtles in areas further away from the coast (Galicia Bank, Celtic Sea and Gran Sol), which could be explained by the presence of a larger continental shelf than off the coasts of France and Ireland, which would in turn imply greater availability of food (Houghton *et al.,* 2006; Sims *et al.,* 2006; Witt *et al.,* 2007a; Caut *et al.,* 2008; Fossette *et al.,* 2010).

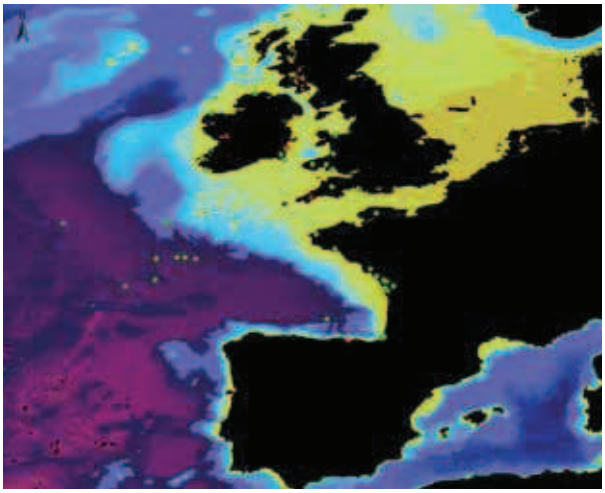

Fig. 2.- *D. coriacea* sightings and strandings in the Bay of Biscay and closest areas in 2009.

2009	Basque Country					
Species	Sightings		Strandings		Bycatch	
	Alive	Dead	Alive	Dead	Alive	Dead
Caretta caretta	1	0	3	1	2	0
Dermochelys coriacea	4	0	0	1*	0	0
Indeterminate	1	0	0	0	0	0
TOTALS	6	0	3	2	2	0

2009	FRANCE					
Species	Sightings		Strandings		Bycatch	
	Alive	Dead	Alive	Dead	Alive	Dead
Caretta caretta	1	0	8	6	1**	0
Dermochelys coriacea	13	0	0	9	0	0
Indeterminate	0	0	0	0	0	0
TOTALS	14	0	8	15	1	0

2009	UNITED KINGDOM & IRELAND					
Species	Sightings		Strandings		Bycatch	
	Alive	Dead	Alive	Dead	Alive	Dead
Caretta caretta	0	0	5	4	0	0
Dermochelys coriacea	15	1	0	5	0	1
Indeterminate	7	1	0	1	0	0
TOTALS	22	2	5	10	0	1

Table 1.- Strandings, sightings and bycatch of sea turtles in the Basque Country, year 2009. Comparative data from France (DELL´AMICO *et al.,* 2010), United Kingdom and Ireland (PENROSE & GANDER, 2010) is also included, in addition to a stranding of *D. coriacea* in Castro Urdiales (Cantabria; Alejandro Gómez Iriberri) (*) and a bycatch of *C. caretta* in France (31st December 2008) (**).

Ingestion of solid residues

Generally speaking, a high mortality rate of sea turtle is due to the ingestion of residues (DUGUY, 1997; DUGUY *et al.,* 1998), although *D. coriacea* is especially sensitive to this threat due to its trophic specialisation (FOSSETTE *et al.,* 2010; JAMES & HERMAN, 2001), with its diet consisting of gelatinous organisms, salpids, jellyfish and others. Plastic bags and residues with a similar appearance to its prey represent a great threat. A sea turtle study carried out on the Basque coast, in which autopsies carried out on 43 individuals, resulted in 22 individuals with plastic residues in their digestive tract (51.1 %). The plastic residues found were of diverse origin, and in some cases very large (DUGUY *et al.,* 1998).

IMPORTANT AREAS FOR CONSERVATION OF THE LEATHERBACK TURTLE IN THE BAY OF BISCAY AND NORTH EAST ATLANTIC

Dermochelys coriacea plays a key ecological role as a major predator of jellyfish and gelatinous zooplankton (GIBBSON & RICHARDSON, 2009; FOSSETTE *et al.,* 2010). The decrease in numbers of this species together with that of other key predators such as some commercially-significant species of fish could have serious repercussions on population control of the species on which they prey and bring about a change that could in turn have unforeseen consequences. Furthermore, they are responsible for passing on nutrients between foraging areas and nesting beaches (BOUCHARD & BJORNDAL, 2000) and play a major role as an oasis in the middle of the oceans where birds and fish can rest and seek protection from predators (PITMAN, 1993). These are just a few examples of the ecological importance of *D. coriacea* in marine and terrestrial ecosystems. We do not know how the reduction in its populations could be affect the ecosystems, whereby plans for its conservation and the protection of habitats where it carries them out are essential. In the case of the Bay of Biscay and the North East Atlantic, there are three foraging areas of great importance to *D. coriacea* (Fig. 3): (1) the Galicia Bank (ECKERT, 2006) (an area being studied as a possible Marine Protected Area), (2) Irish waters (Irish Sea and Celtic Sea; HOUGHTON *et al.,* 2006) to the north of the Bay of Biscay, and (3) a third area that has yet to be confirmed off the coast of La Rochelle, the Pertuis Charentais, which is currently classified as a Site of Community Importance (SCI) in the Gironde estuary, on the French Atlantic coast. This last-mentioned has shown a high number of sighted and stranded *D. coriacea* specimens (Doyle & Morinière, pers. comm.; see Fig. 4), in addition to a high concentration of gelatinous zooplankton (Doyle, pers. comm.), and as facing a potential threat from trawling in the vicinity. This place is actually a Protected Marine Area (http://www.aires-marines.fr/L-Agence/Organisation/Missions-d-etude-de-parc/Gironde-Pertuis) and French Government plans to create a marine nature reserve there.

Generally-speaking, the designation of areas of special importance or especially vulnerable ones (Marine Protected Areas) is considered to be one of the most important tools available for protecting species and habitats. In the specific case of the Cantabrian coast, declaring an area an MPA for inclusion in the Natura 2000 Network has not hitherto been a priority in either autonomous or state administrations. The Cabinet declared the first Marine Protected Area in Spain in 2008 in El Cachucho (Asturias). The Galicia Bank is currently being studied, as this is a major habitat for *D. coriacea*

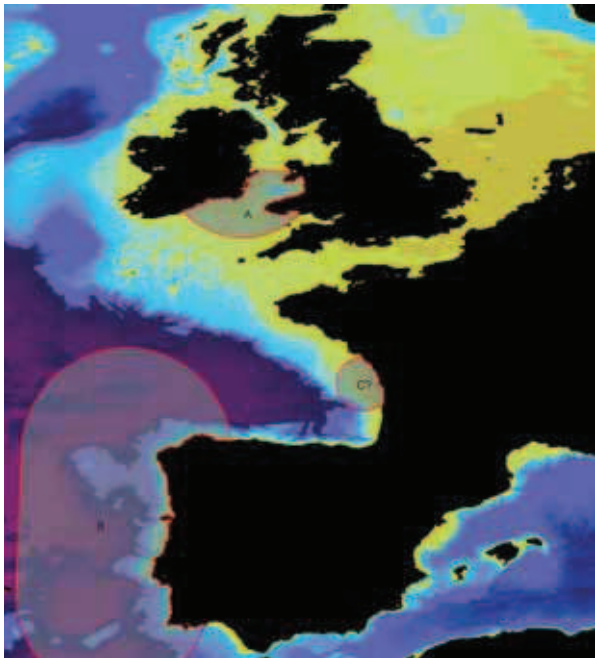

Fig. 3.- *D. coriacea* foraging grounds in the Nord East Atlantic.

(ECKERT, 2006) and many other species, and a place where a great number of fishing fleets operate, with the resulting possibility of bycatch, collisions and destruction of habitat, etc. For all the aforementioned reasons, management plans are needed to integrate ecosystems, resources and endangered species.

CONCLUSIONS

Dermochelys coriacea continues to be an unknown species in the Bay of Biscay and the North East Atlantic. Generally speaking, research into conservation of this species is not at present a priority. This is a predator with very few competitors and, given its trophic specialisation, it is not known whether its absence could alter the trophic network in the foraging areas it frequents. Thus, the influence it has on bringing about changes that would affect these habitats and/or anthropogenic activities carried out in them such as fishing or tourism has not been assessed.

Fig. 4.- *D. coriacea* feeding on a barrel jellyfish *Rhizostoma octopus* in front of La Rochelle coastline, Bay of Biscay in 2007. Photography: Bateau École des Douanes, La Rochelle/Aquarium La Rochelle S.A.S.

Greater knowledge about the oceanography of the Bay of Biscay, its habitats and species is required in order to understand the relationship existing between the physical-chemical and biological complex in this part of the North East Atlantic.

The conservation of biodiversity and habitats must be made a priority. The creation of MPA is not enough, but it is necessary to ensure that ecosystems are recovered and increase their resilience – also in this area of the North East Atlantic.

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