

DIFFERENTIAL TEMPORAL AND SPATIAL DISTRIBUTION OF ADULT LOGGERHEAD SEA TURTLES FROM GULF OF CÁDIZ TO WESTERN MEDITERRANEAN SEA

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SEA TURTLE
BY-CATCH
STRANDING
MEDITERRANEAN SEA
MIGRATION

ABSTRACT. – The aim of this paper was to search for and model spatial and seasonal trends in occurrences (stranding or by-catches) of adult loggerhead turtles in the western Mediterranean area and Gulf of Cádiz (Atlantic) independently of their origin. Adult turtles were only bycaught on longlines from May to August. Adults were stranded in the eastern and western areas of the Strait of Gibraltar threshold throughout the year. In the Gulf of Cádiz (Atlantic), strandings were significantly concentrated in May and June, whereas in the Alboran Sea (Mediterranean), strandings mainly occurred in June and July. The probability of catching a mature loggerhead increases during June and July south of the Balearic Islands. The results suggest that adult loggerhead turtles move (migrate) from the Atlantic area (Gulf of Cádiz) to the Mediterranean (Alboran Sea) from May to June, and subsequently move to the Balearic Sea from June to July. These results are in line with those obtained by previous studies.

INTRODUCTION

Sea turtles have relatively high fecundity and low natural mortality during the adult phase (Musick 1999). In contrast, immature individuals (hatchlings and juveniles) present high natural mortality rates (Wallace *et al.* 2008). For this reason, mature-phase mortality due to fisheries has a higher impact on sea turtle populations than non-natural immature-phase mortality (Wallace *et al.* 2008). By-catch in longline fisheries is considered to be a critical global threat to loggerhead turtles *Caretta caretta* (Linnaeus, 1758) (Lewison *et al.* 2004), and is particularly severe in the Mediterranean Sea (Camiñas *et al.* 2006, Báez *et al.* 2007a,b). According to recent studies, by-catch frequency and size differentiation of loggerheads is a function of surface longline gear-type (*e.g.* Báez *et al.* 2013). Thus, in the Western Mediterranean, surface longliners targeting albacore (LLALB) using smaller hooks tend to capture smaller loggerheads, but have the highest by-catch per unit of effort (BPUE), whereas other longliners, such as traditional surface longliners targeting swordfish (LLHB) using larger hooks tend to capture larger animals; moreover, LLHB have the lowest BPUE (Báez *et al.* 2013).

In the western Mediterranean, loggerhead sea turtle specimens from the Mediterranean, Northeast American, and Cape Verde populations are present (Monzon-Arguello *et al.* 2010). The western Mediterranean contains loggerheads in different life stages (mainly subadults). They are captured as by-catch in several fisheries: driftnets (Silvani *et al.* 1999, Tudela *et al.* 2005), drifting longlines

(Camiñas 1988, Aguilar *et al.* 1995, Camiñas & Valeiras 2001, Báez *et al.* 2007a,b), bottom trawling (Casale *et al.* 2004), and trammel nets (Carreras *et al.* 2004, Lozano *et al.* 2011); however, there is a lack of reliable information on the relative contribution of each fishing gear to the total by-catch. Other gears that affect total mortality in sea turtles have been evaluated by Álvarez de Quevedo *et al.* (2010).

Although some nests are present in the western Mediterranean (Bellido *et al.* 2015), nesting grounds for the Mediterranean loggerheads concentrate in the eastern basin (Margaritoulis *et al.* 2003). The Balearic Sea is considered a foraging area for immature and subadult loggerheads; individuals from the three mentioned populations from the Mediterranean Sea and Atlantic Ocean converge in this area (see for example, Camiñas & de la Serna 1995). The recent observations of nesting loggerheads in the Western Mediterranean have revived a debate about the use of the Iberian Peninsula coast as a recurrent nesting area for loggerheads (Tomás *et al.* 2002, 2008, Bellido *et al.* 2015). Unfortunately, neither regular net monitoring, nor rigorous studies on the abundance and distribution of adult individual loggerheads in this area have been conducted on Spanish beaches.

The aim of the present article was to look for spatial and seasonal trends in occurrences (stranding or by-catches) of adult loggerhead turtles in the western Mediterranean area and contiguous Gulf of Cádiz (Atlantic), independently of their origin.