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Analysis of the loggerhead (*Caretta caretta*) bycatch in mediterranean surface longlines from depth sensors data

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Resumen: En este trabajo se analiza la relación entre las características del hábitat pelágico explotado por los palangreros españoles dirigidos al atún blanco (*Thunnus alalunga*), en el Mediterráneo occidental, y las capturas ocasionales de tortuga boba (*Caretta caretta*). Entre julio y octubre de 2008 (93 días) el Instituto Español de Oceanografía (IEO) realizó una campaña científica de pesca experimental en colaboración con la flota de palangre de superficie, con el objetivo de analizar los efectos de este aparejo en las especies objetivo y de captura ocasional. Nuestros resultados indican que la temperatura es una variable clave en relación a la captura ocasional de tortugas marinas.

The Spanish surface longline fleet in the western Mediterranean is monitored on board and at landing ports by the IEO from more than 20 years ago due to the commercial importance of the target species: swordfish (*Xiphias gladius*), bluefin tuna (*Thunnus thynnus*), and albacore (*Thunnus alalunga*). Marine turtles species caught as bycatch include loggerhead (*Caretta caretta*) as the most frequent one, although leatherback (*Dermochelys coriacea*) and sometimes green turtle (*Chelonia mydas*) are also present (Camiñas *et al.*, 2006; Báez *et al.*, 2013).

The Spanish surface longline fleet operates with six different gear/target species (called "métier", as referred to in the EU Commission). One of the main distinctive technical features among métiers is the depth range in which the baited hooks are setting (Báez *et al.*, 2013). Depth of setting hooks varies from surface waters (average depth of 30 m, with a maximum of 50 m) to over 400 m deep. Each métier exploits a different part of the pelagic habitat, changing the species of both components of the capture, the target and bycatch. For more detail see Camiñas *et al.* (2006),

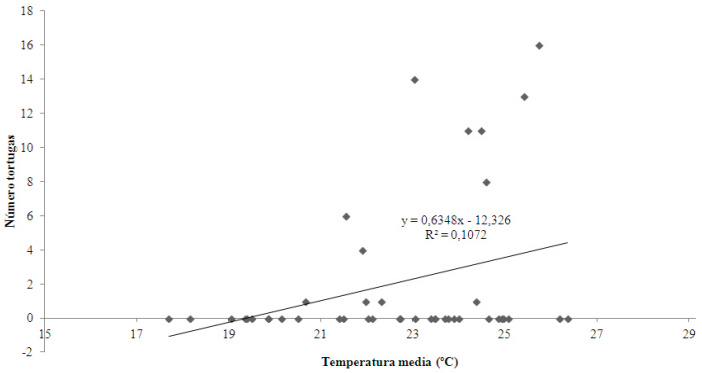

Figure 1: Plotted between the numbers of loggerhead sea turtles bycatches per set *vs.* average temperature (ºC). We indicate the significant positive linear relationship between both variables.
Figura 1: Representación del número de capturas incidentales de tortugas marinas por lance y la temperatura media (ºC). Se indica la relación lineal positiva significativa entre ambas variables.

Báez *et al.* (2007a, b) and García-Barcelona *et al.* (2010a, b).

The surface longline targeting albacore (LLALB thereafter) captures more loggerhead per unit effort (Báez *et al.*, 2013) than the other five Spanish longlines métiers targeting tuna and swordfish in western Mediterranean Sea.

The main aim of this paper is to improve the understanding of the relationship between the characteristics of the pelagic habitat exploited by the LLALB gear and the bycatch of loggerhead sea turtle. In this sense, the habitat of the water column is defined by two main environmental parameters, depth and temperature.

An experimental scientific survey in collaboration with the surface longline fleet targeting albacore was carried out by the IEO from July until October 2008 (93 days) to analyze the gear effects on target and bycatch species. During the survey, Micrel® sensors recorders were attached to hooks' lines ("brazolada") in different LLALB sets. Sensors recorded depth and temperature (within water column) from setting to hauling the gear following a time registration schedule previously decided.

A total of 105 472 hooks were monitored on board and 87 loggerhead were recorded. There was a statistically significant correlation between average temperature and the number of turtles caught (r= 0.327; P= 0.032) (Figure 1). We did not find any significant correlation between average fishing depth and number of turtles caught (Figure 2). Fishing depth of the longline gear targeting albacore ranges from 30 to 90 m.

Our findings stated that temperature is a key environmental variable related to the bycatch of sea turtles with this gear (r= 0.327; P= 0.032), that is according with previous studies (for example Watson *et al.*, 2005). At the

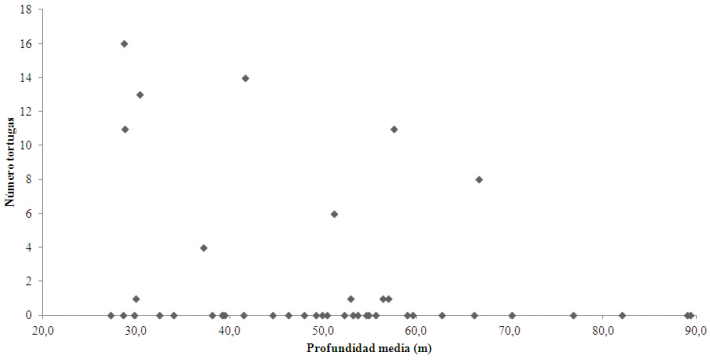

Figure 2: Plotted between the numbers of loggerhead sea turtles bycatches per set *vs.* average depth (m). We do not observe significant relationship.
Figura 2: Representación del número de capturas incidentales de tortugas marinas por lance y la profundidad media (m). No observamos relación significativa.

same time our results point out other environmental and technological variables with major statistical importance: baits, distance to the coast, sun time or moon phases (Báez *et al.*, 2007a, b, 2010, 2013; Mula *et al.*, 2013).

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Descripción de un método sencillo de identificación de crías de galápagos en proyectos de cría en cautividad

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Los proyectos de conservación de galápagos amenazados en los que se realiza la cría en cautividad tienden a maximizar la producción de juveniles con el fin de incrementar el número de ejemplares a reintroducir. Sin embargo, producir un gran número de crías tiene importantes implicaciones para el manejo y control durante su estabulación hasta el momento de su reintroducción en el medio natural. Este es el caso del programa de reproducción de galápago europeo *Emys orbicularis* que se desarrolla en las instalaciones del Centre de Fauna Salvatge del Canal Vell (CFSCV - Parc Natural del Delta de l'Ebre).