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REPORT ON NESTING ACTIVITY ALONG THE MEDITERRANEAN COAST OF SPAIN (2001-2019), WITH ADVANCES UNDER THE SCOPE OF PROJECT LIFE MEDTURTLES

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Summary

Since 2001, sporadic loggerhead sea turtle nests and nesting attempts have been recorded in the Spanish Mediterranean coasts, as well as in other coasts of the European western Mediterranean, in what seems to be an increasing trend in nesting of this species in this basin. In Spain this trend is notorious since 2014, with records in Spain's beaches every year. Protection and management for successful incubation of eggs has been variable among regions, including *in situ* protection and relocation to incubators or to protected beaches. Relocation have been mandatory in many cases since most of the nests have been laid in urban/tourist beaches featuring promenades, buildings, lighting over the beach, and many of them being cleaned every morning with machinery. In fact, at least nine nesting attempts have failed due to human disturbance on the nesting turtle. In the present report we include the information on these nesting events describing the conditions affecting their success, the management strategy applied and discussing their conservation implications. From 2001 to 2019, a total of 21 clutches and other 29 unsuccessful events have been recorded in the different Spain's Mediterranean regions. The team of the University of Valencia (UVEG), with 25 years of experience in studies on reproduction of sea turtle, has participated in the finding, relocation and study of 7 out of these 21, relocating 6 of the. All relocated clutches were successful (range: 31.4-84.5 % of hatching success), allowing to undertake head-starting programs and studies based on satellite telemetry of 1-2 years old post-hatchlings. The fact that these nesting events are sporadic and spatially disperse over more than 2000 km of coast (including the Balearic Islands) makes difficult their detection, particularly in regions where stranding networks are not well developed. Hence, we cannot discard that more nesting events are occurring in this coast. In fact, most of the events were detected during weekends and in visited beaches. Implications of the different management practices, including the study of beach conditions and the effect of incubation temperature in relocated clutches, are in study and discussion at national level in order to increase the success of these sporadic nests and to analyze their value for long-term sea turtle conservation in the region. These nesting events, although sporadic, have been proven to be a successful way to involve public and private institutions in the conservation and awareness of this species in the region. Public awareness and training campaigns have been carried out over the last years in order to increase detection of these events. However, the economic support of conservation projects and institutions is necessary for a successful protection of the clutches in order to keep this increasing trend in numbers. Here we also include the significant improvement in clutch detection and protection in 2020 thanks in part to the project LIFE MEDTURTLES.

Introduction

From the seven species of marine turtles, only two have been recording nesting in the Mediterranean coasts: the loggerhead sea turtle (*Caretta caretta*) and the green sea turtle (*Chelonia mydas*) (Casale et al. 2018 and references therein). Other species have been recorded in this sea, although never nesting. Genetic studies have revealed that either loggerhead and green turtle Mediterranean populations have some grade of isolation from Atlantic nesting populations. However, genetic interchange through males may occur. The entry of Atlantic loggerhead turtles in the Mediterranean is a well reported phenomenon (Clusa et al. 2014 and references therein). What is not precisely known is the level of contribution of these Atlantic turtles to the Mediterranean nesting stocks.

Marine turtles are threatened worldwide. In the Mediterranean Sea, marine turtles are threatened mainly by fisheries by-catch, tourism development, and by the increasing of human population in the coasts. Other threats that deserve consideration are the increase of maritime traffic and the international conflicts, both also contributing with litter and oil spills to the spectacular increase of water pollution in this sea. However, coastal development and tourism activities threat seriously existing marine turtle nesting rookeries, and prevent either new nesting activity in depleted nesting beaches or the establishment of new nesting rookeries.

Main marine turtle nesting activity concentrates in the Eastern Mediterranean basin, with higher sea surface temperatures than in the Western basin. The loggerhead sea turtles nest mainly in Greece, Turkey and Cyprus. Higher nest densities are recorded annually in Greece, mainly in Zakynthos island, Kyparissia Bay and Crete. Other less important nesting areas for this species are located in Syria, Lebanon, Israel, Egypt and Tunisia (Casale et al. 2018). Occasional nesting is also recorded in the central Mediterranean, particularly in the south of Italy (Linosa and Lampedusa islands, south of Sicily, Ionian coasts and Adriatic-Apulian coast; Casale et al. 2018 and references therein). However, more nesting areas have been discovered and surveyed recently in the south of Italy, and the current genetic structure of *C. caretta* rookeries in the Mediterranean would be the result of at least two colonization events from the Atlantic, being the most recent in Calabria (South Italy) (Clusa et al. 2013).

Until the beginning of the 21st century, there are only sporadic evidences of loggerhead turtle nesting in the western Mediterranean. It is `possible that the coasts of the Spanish Mediterranean received turtles that nested on its beaches in the past; although the lack of documentation makes impossible to determine whether this nesting activity was sporadic or if there was stable nesting in the past. In any case, this nesting activity would would have disappeared with the demographic growth and the development of tourism in the Spanish Mediterranean. Llorente et al (1993) quote the presence of a loggerhead hatchling found dead on a beach in the Ebro Delta. However, no nest was reported until 2001, when a loggerhead turtle was observed nesting in the municipality of Vera (Almería) (Tomás et al, 2002). This successful nesting event woke up the interest of the Spanish scientific community and authorities, starting to take actions to locate and study loggerhead sea turtle nesting events in Spain. Since 2001,

sporadic loggerhead turtle nests and nesting attempts have been recorded in the Spanish Mediterranean coasts, as well as in other coasts of the European western Mediterranean, in what seems to be an increasing trend in nesting of this species in this basin. Genetic analyses suggests that these nests were colonizing events associated with developmental juveniles foraging grounds from distant populations, both Mediterranean and Atlantic (Carreras et al. 2018).

Here we include the information related to loggerhead turtle nesting activity in the Spain's Mediterranean coasts from 2001 until 2019, including the participation of the team of the University of Valencia (UVEG) in the studies and management of these nesting events, and also the significant improvement in clutch detection and protection in 2020 thanks to the project LIFE MEDTURTLES and other conservation and research projects.

Nesting activity in Spain

About 50 nesting events (21 successful with egg laying) have been recorded in the Spain's Mediterranean coast between 2001-2019. Also 5 of the nests were recorded before 2014, and the other 17 from 2014, with an average of 3 nests per year recorded from 2014 to 2019 (Figure 2). A total of 5 out of these 21 nests were recorded in the Valencia Region beaches. Also, from these 21 nests, 5 were detected when observing hatchlings crawling by the beach later in the summer months. Moreover, from the 29 unsuccessful emergences several included different tracks on the same beach or turtles trying to nest but disturbed by passers-by, and never seen again. This may indicate that we are not recording all the nests, particularly the ones produced in natural/protected beaches, and that increasing in survey effort must be done in order to locate, study and protect all the clutches laid.

These nesting events are dispersed over more than 2000 km of coastline from Catalonia to Andalusia, including the island of Ibiza, in the Balearic Islands. These areas have warmer waters than the rest of the Spanish coast. However, very warm beaches in South Spain have no records of nesting. Spatial concentration of nesting events have been recorded just once, with 7-9 female emergences recorded in the same area, between Manga del Mar Menor and the Calblanque Natural Park (Murcia region, Southeast Spain) in 2017. In some years, there was an apparent displacement of nesting females throughout the nesting season from northern to southern areas, but more evidence is needed to confirm this. The high level of dispersion of nesting events makes difficult their detection, especially in those regions with not consolidated stranding networks, another reason to state that the number of nesting events may be greater than the recorded. Social awareness and training campaigns, developed with the support of the institutions in recent years for the detection of these nests during the summer months (June-September), should be promoted in order to record as much as nesting events of this species in our coasts.

Figure 1. Political regions of the Spanish Mediterranean. The UVEG team has been working in loggerhead turtle nesting, and is undertaking LIFE MEDTURTLE activities, in the Valencia Community; although it has assisted teams and authorities in other regions, particularly in Murcia and in the Balearic Islands.

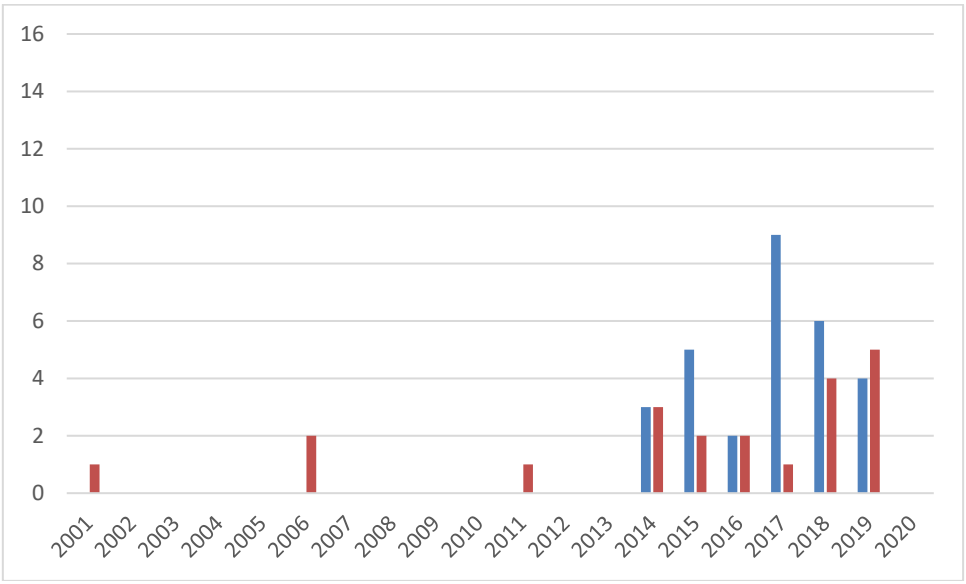


Figure 2. Annual number of nests (red) and nesting attempts (blue) recorded in the Spanish Mediterranean coasts from 2001 to 2019 (both included).

As said before, the nesting activity recorded has been scattered among regions, with years including most of the records in northern regions and years concentrating in the South of Valencia region and Murcia (Figure 3). Despite not being the region with more records of nesting activity (that is Catalonia), the Valencia Community has been the only region with records every year sin 2014. This is probably because the UVEG team coordinates, with the regional government, a 30-year-old stranding network in the region with the use of the emergency call number (112) to report cetacean and sea turtle strandings to the network. Through awareness campaigns since 2015, this network has been useful also to receive reports on nesting activity in this region.

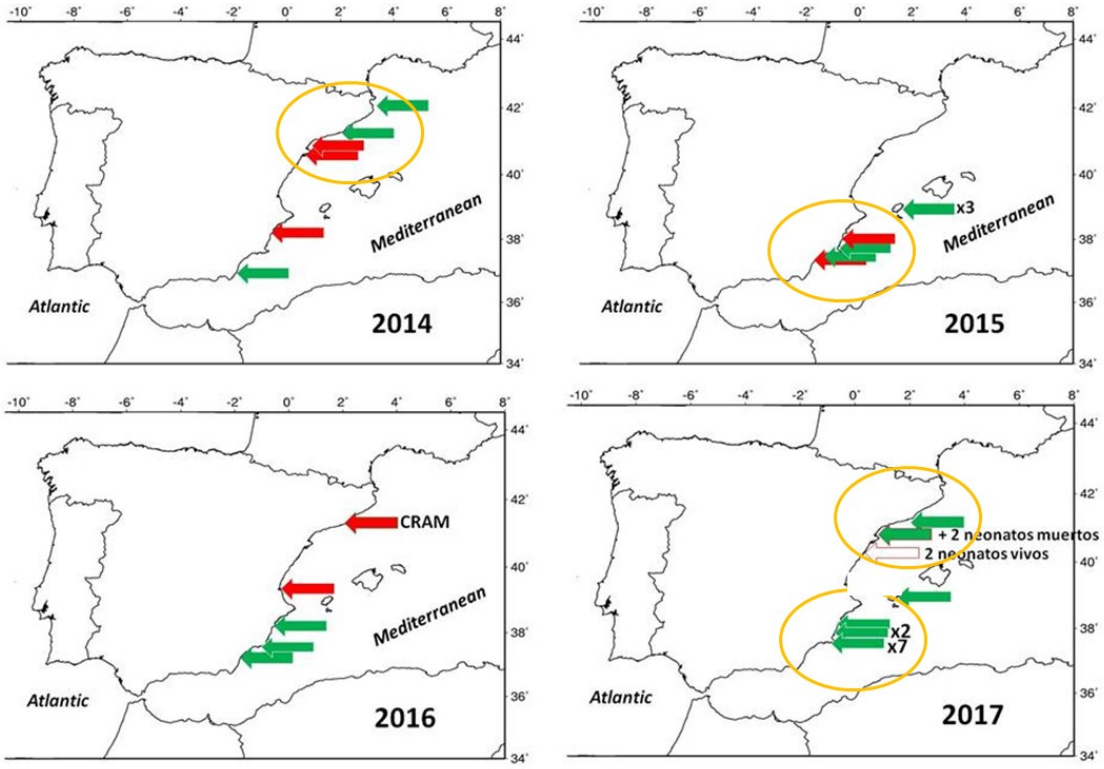


Figure 3. Nests (red) and nesting attempts (green) recorded in the Spanish Mediterranean coasts from 2001 to 2019 (both included). Yellow circles indicate areas of observed concentration of records. Numbers indicate different activities in the same beach/area and/or the finding of hatchlings walking on the beach or at sea-shore, such as the detection of two hatchling in Peñiscola beach in 2017 (white arrow).

Increasing efforts at regional and national level

As the records increased, so did it the interest of marine turtle specialists, national and regional authorities and stranding networks and rescue centres. In 2017, the UVEG team, together to other research and conservation institutions and the regional government, agreed in a protocol for the actions to be carried out in relation to sea turtle nesting events in the Valencia Community. This protocol contributed to the creation of a National Protocol promoted by the Spanish Ministry of Ecological transition as part of the actions of the project LIFE15 IP ES 012 – INTEMARES. On November 27th 2018, this ministry and the regional government of the Valencia

Community organised a workshop in Valencia with the participation of a panel of experts, including J Tomás from the UVEG team. This workshop has the aim of compiling information on previous scientific data and on management techniques carried out in the previous nesting events, in order to find consensus and create a National Protocol for acting on nesting events in the Spain's Mediterranean coasts (see below).

These increase in coordination among institutions resulted in more records of nesting events. In 2018, four nests and other events were recorded in Catalonia, and the team of the Valencia Community (VC) managed to reach, satellite tag and track three nesting loggerhead turtles in beaches of these region, although none of them laid eggs, at least in the region. The VC team also recorded a fourth different nesting female in that season (Figure 4). The season 2019 showed an increase, with records of successful nests (5) in 4 out of the 5 regions of the Mediterranean coast, plus other 4 emmergences recorded (Figure 4). The UVEG team protected the nest laid in Castellón province (Valencia Community) and assisted teams of Balearic Islands and Murcia in protecting their nests, including the relocation of the clutch found in Murcia region.

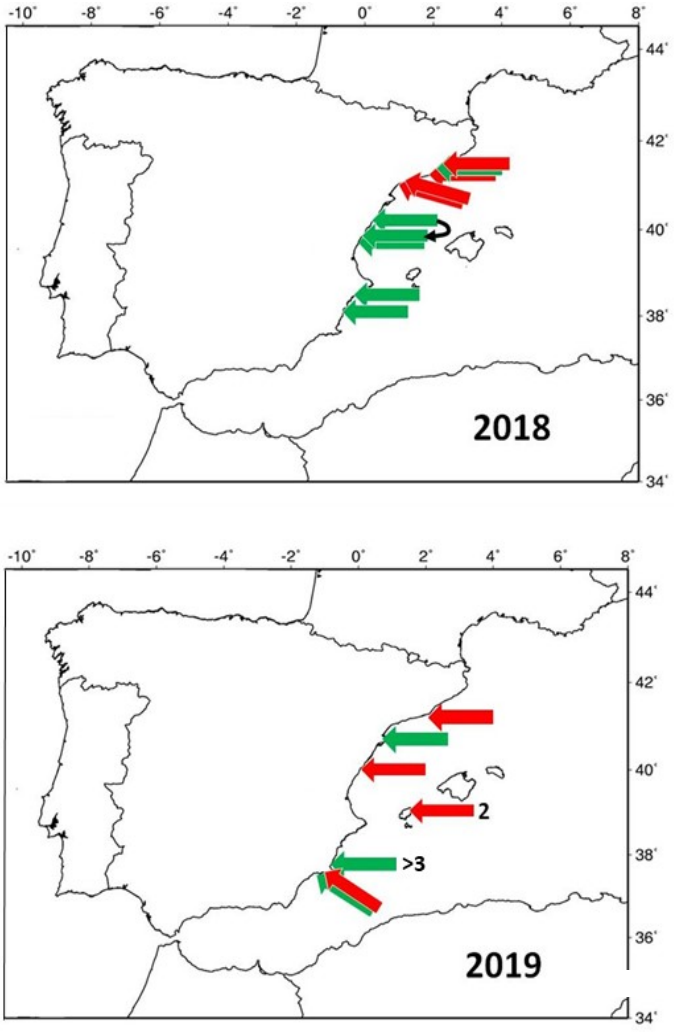


Figure 4. Nests (red) and nesting attempts (green) recorded in the Spanish Mediterranean coasts in years 2018 and 2019. Black arrow in 2018 map indicates two nesting attempts of the same turtle in different beaches.

Clutch management

Clutch management differed among regions, from *in situ* incubation and protection to different degrees of relocation: 1) to a safer place inside the same beach of nesting, 2) to an artificial incubator in rescue centre facilities, 3) to a protected beach. Every strategy depended on different factors, including the characteristics of the original beach (particularly looking at human activities and potential threats for the clutch), the availability of a proper protected beach in the region, the presence of teams with experience in relocation, and potential awareness campaign.

In the Valencia Community the strategy chosen has been relocation since 2006, because all clutches recorded have been laid in urban-tourist beaches cleaned with machinery and with high degree of use by tourists. The clutch laid in 2006 in Puzol (Valencia province), was relocated into a protected beach at the Natural Park of l'Albufera (nearby Valencia city) by the UVEG team. After a successful emergence of hatchlings, this beach has been used for clutch incubation other 5 times (2014, 2015, 2016, 2019 and 2020) all them successful. However, since 2014, the Valencia Community is using a mixed strategy, moving part of the clutch for incubation in artificial incubators as a reserve in case of having dramatic climatic events affecting the protected beach (Figure 5). The other regions have been adopting similar strategies of clutch management in the recent years.

Figure 5. Finding and management of clutch laid in San Juan beach (Alicante province, Valencia Community) in 2014, including: Turtle sighting by passers-by, location of the clutch and relocation by the UVEG team, relocation into incubators and at a protected beach, clutch protection until emergence of hatchlings and head-starting program at the rescue centre.

After hatchling emergence, again a mixed strategy has been adopted, with a number of the hatchlings being released at the original beach and a number of them being included in a one-two year head-starting program. These programs have the aims of (1) reducing mortality by predation, and (2) allowing research to gain information on these potential colonizers, including genetic origin of the parents, multi-paternity in clutches, sex-ratio, or the identification of development grounds through satellite telemetry.

These genetic studies allowed to identify the Atlantic origin of many of the turtles nesting and many of the males involved in these events, supporting the colonization theory. Sex-ratio studies in hatchlings is also helping in choosing beaches for relocation looking for adequate temperatures for embryo development and natural sex-ratio including female production, since several beaches in the Spain's Mediterranean coast may be still a bit cooler for successful loggerhead turtle reproduction.

Management of sea turtle nesting activity in Spain under the project LIFE MEDTURTLES

Following the meeting organised by the Spanish Ministry for the Ecological Transition (MITECO) in Valencia in 2018, a debate and exchange of experiences among sea turtle specialists, including the UVEG team, the ministry and environmental offices of the regional governments has been frequent. In January 15th 2020, J. Tomás (UVEG) attended a meeting organized by the Spanish Ministry in Madrid to discuss the strategy for marine turtle conservation in Spain. This meeting included a workshop on nesting activity by loggerhead sea turtle in Spain. Representatives of the environmental departments of Regional governments and a panel of sea turtle researchers were invited to this meeting, in which the UVEG team explained the actions to be carried out in the Valencia region for turtle nesting activity during the LIFE MEDTURTLES project. During this meeting the Action Plan for marine turtle conservation and the protocol for managing nesting events were discussed.

UVEG team (J. Tomás) also participated in the two days online meeting organised on March 10th-11th 2020 by the technicians of the Spanish Ministry with the panel of sea turtles research experts. In this meeting it was discussed the actions related to conservation and management of nesting females and clutches throughout the Spanish Mediterranean coasts. This meeting was organised to find consensus and better define strategies and management recommendations to be included in the Nationa Protocol for nesting sea turtle conservation in Spain.

After this meeting, a draft of the protocol was forwarded to the experts (including J. Tomás) for final amendments, in order to have a definitive version to be applied in all the Spanish Mediterranean Regions from Summer 2020. The UVEG team reviewed three different versions of this draft for the Spanish Ministry. When the draft was sent to regional governments to receive their input in May 2020, the Regional government

of the Valencia Community asked the UVEG team to review it again and adapt it to Valencia Region needs.

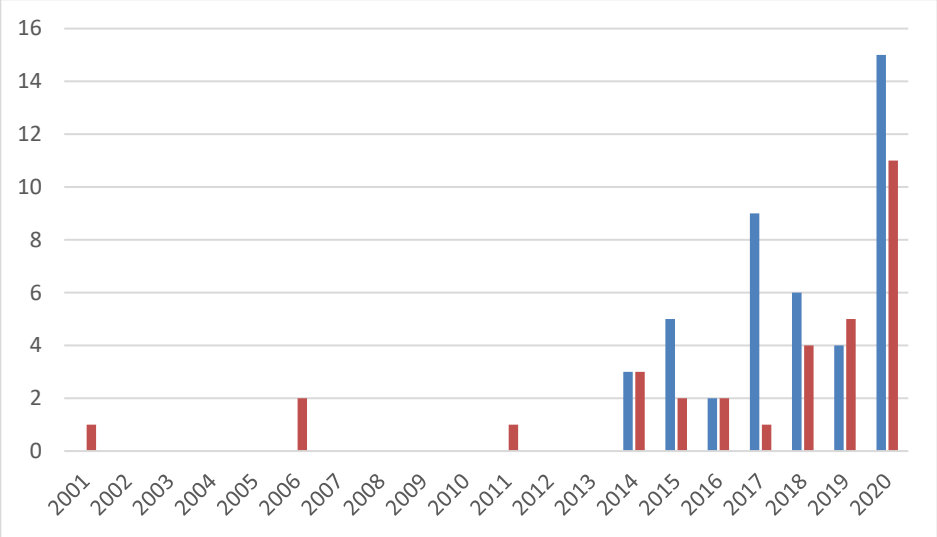
A definitive version of the '*Acting common protocol for attending nesting events of marine turtles in Spanish coasts*' was released by the Spanish Ministry in September 2020 and distributed to the different Regions. Then, the dissemination of the protocol and action plan to municipalities and stakeholders has been delayed to the 2021 nesting season. UVEG team is in close contact with technicians of the Spanish Ministry of Ecological Transition to prepare and coordinate actions related to detection and protection of nesting activities in the following seasons. Furthermore, the UVEG team is in close contact to other teams formed by Regional governments, universities and rescue centres, in other Spain's Mediterranean Regions to coordinate the actions and to exchange information on nesting activity in the Spain's Mediterranean beaches. These contacts resulted in close collaboration and specific actions in nesting events and clutches laid in Murcia region in 2020, including the relocation of one clutch to a safer place and the finding of a clutch (after detecting hatchlings crawling on an isolated beach) by the UVEG team.

Finnally, on May 10-11th 2021, the Spanish Ministry for Ecological Transition and Demographic Challenge, under the project LIFE INTEMARES, organised the '*TRAINING ACTION: SATELLITE MARKING OF LOGGERHEAD SEA TURTLE REPRODUCTIVE FEMALES FOR THE FIRST ATTENTION TO THE NESTING EVENTS ON THE SPANISH COAST*' in Valencia. The objective of this training action was to support those responsible of taking action attending the sea turtle nesting events in the different Mediterranean regions of Spain, as well as training managers and technicians to be specialized in the processes of detection, management and handling of females and clutches of the species. The training action had also the objective of standardizing best methodologies for detecting and protecting nests among regions. J. Tomás, from UVEG team, was invited as speaker and consultant to this meeting, sharing experiences and knowledge with technicians and managers of the environmental offices of the regional governments from Catalonia, Balearic Islands, Murcia and Andalusia, as well as with members of public and private rescue centres of these regions. In this meeting, J. Tomás gave also the conference entitled: '*Nest translocation: egg management, excavation of the new nest and monitoring of incubation*'.

In this meeting, the "Acting common protocol for attending nesting events of marine turtles in Spanish coasts" was communicated to managers in every region, with some aspects still put in discussion among attendees and experts invited to the meeting. The UVEG team consolidated contacts with technicians and managers of the different Spanish Mediterranean regions to coordinate actions to protect loggerhead turtle nests in the incoming 2021 nesting season.

Before these coordination efforts among regions and institutions, the UVEG team has been attending loggerhead turtle nesting events in Spain since 2001, most of the times using particular funds. Clearly the Valencia Community has been beneficiated from the experience of the UVEG team, with 6 successful relocation clutches, many nesting attempts recorded and four adult nesting females satellite tracked. This experience has

also beneficiated other regions, as said before, consolidating the UVEG team as a reference in attending nesting events of marine turtles in Spain. The LIFE MEDTURTLES project has provided resources for this team to increase effort and efficiency in attending these events, both in the Valencia Community and neighbouring regions. Although the increasing trend of nesting activity was already observed (see Figure 2), the results on nesting records in 2020 has been remarkable (Figures 6 & 7), probably due to these collaborations among institutions, the consequent increase in awareness campaigns and the support of conservation projects such as LIFE MEDTURTLES.



Fugure 6. Annual number of nests (red) and nesting attempts (blue) recorded in the Spanish Mediterranean coasts from 2001 to 2020 (both included).

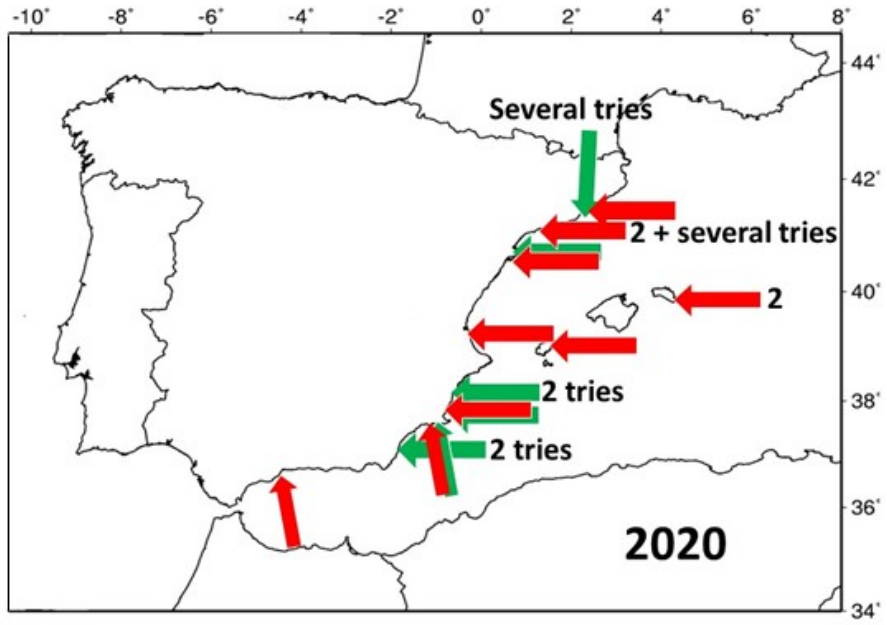


Figure 7. Nests (red) and nesting attempts (green) recorded in the Spanish Mediterranean coasts in 2020.

The increasing in records probably reflects more the increasing in effort, allowing the detection of nests in natural beaches much less visited. Furthermore, the increasing of records is allowing to increase knowledge of this potential colonizing stock of nesting loggerhead turtles. For instance, two areas of special concentration of nesting events seems to be defining: the South of Catalonia region and the area including South of Valencia Community and the region of Murcia; although nesting is still scattered throughout the coast. Moreover, first remigrants (i.e., turtles nesting in different seasons) have been detected thanks to tagging and satellite telemetry applied on nesting females. Also, different nesting strategies have been observed, with some turtles exhibiting a certain degree of philopatry and other turtles nesting consecutively, within the season and/or between seasons, in beaches hundreds of kilometres away.

After the coordination meetings and expert discussion made during the last two years, and with the support of the LIFE MEDTURTLES project, the UVEG team is expecting an amazing 2021 season, with actions to be carried out both in the Valencia Community and assisting in neighbouring regions.

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