Swansea University
Prifysgol Abertawe

European Science Foundation – Short Visit Grant - ThermAdap

Short Visit Report

Reference number: 3477
Activity title: Thermal adaptation in ectotherma: linking life history, physiology and genetics

Title of research project:

The role of environmental temperature as a driver of reproductive output for an endangered ectotherm at its range limit

Researcher: Dr. Gail Schofield

Host Institute: Professor Graeme C. Hays, Institute of Environment and Society, Swansea University, United Kingdom

Period: 15/11/2010-30/11/2010 (15 days)

Purpose of the visit
The purpose of this visit was to initiate research on the role of temperature in driving reproductive fitness of female loggerhead turtles (*Caretta caretta*) breeding at the Mediterranean's largest rookery in Zakynthos, Greece (Figure 1-2). At this site I have previously shown how cold early season water temperatures constrain the onset of breeding. Here, I proposed to work with the biotelemetry group at Swansea University to use tracking equipment to assess the links between clutch frequency of individuals and water temperature.

Description of the work carried out during the visit
I first gathered existing literature on several themes that I intend to combine in this research (1) the classification of different types of diving behaviour (2) general information on internesting behaviour (3) parameters that may influence clutch frequency.

I subsequently received training by members of the research group led by Professor Graeme Hays at Swansea University in using specialised programmes to isolate and record different dive categories. I spent the remainder of the two weeks compiling a detailed database classifying the different dive categories for the studied turtles in parallel to recording the temperature experienced by individuals. Where possible, these records were compared with GPS location to determine the actual bathymetry available to the turtle during different bouts of diving.

Description of the main results obtained

For three tracked turtles, I assimilated a database on over 3000 dive records, including information on dive type and depth, as well as temperature experienced. The mean and maximum daily temperatures experienced by the female turtles was on average 2 ºC and 3 ºC (and as much as 6 ºC) greater than that of sea surface temperature recorded at depths of 3 m. In early May (6-10 May), the temperature experienced by the turtles was about 18 ºC. This was subject to a steady increase to 24-25 ºC at the end of May/beginning of June, at which point the temperature experienced by all turtles appeared to start levelling out (Figure 3). Sea surface temperature records in water of 3 m depth for this period indicate ambient temperatures of 25 ºC were reached after 25 June. Hence these preliminary datasets indicate that the turtles were locating warmer sources of water. In addition, the maximum temperature experienced on a given day differed with respect to different individuals by as much as 4 ºC. Furthermore, the data indicated that in the week prior to nesting, the turtles were resting in water in excess of 26 ºC, with a maximum of 30 ºC used by some individuals. There appeared to be distinct individual variation was noticed with respect to the duration spent in water above 26 ºC, which requires further consideration with respect to the implications on stress to the body's physiological conditions (i.e. costs) versus the impact on egg development rates (i.e. speeding up) allowing the production of more clutches (i.e. benefits). Investigation of the dive profiles indicated that the turtles were less active at night, with activity increasing during the day when the sea temperature was warmer. The implications of these observations require further investigation. The assimilated data indicate that the female turtles are responding to changes in the thermal environment. However, due to the small sample size, I plan to include data obtained in previous years to provide more information on individual variation, as well as validate the upper threshold thermal limits indicated from the current datasets.

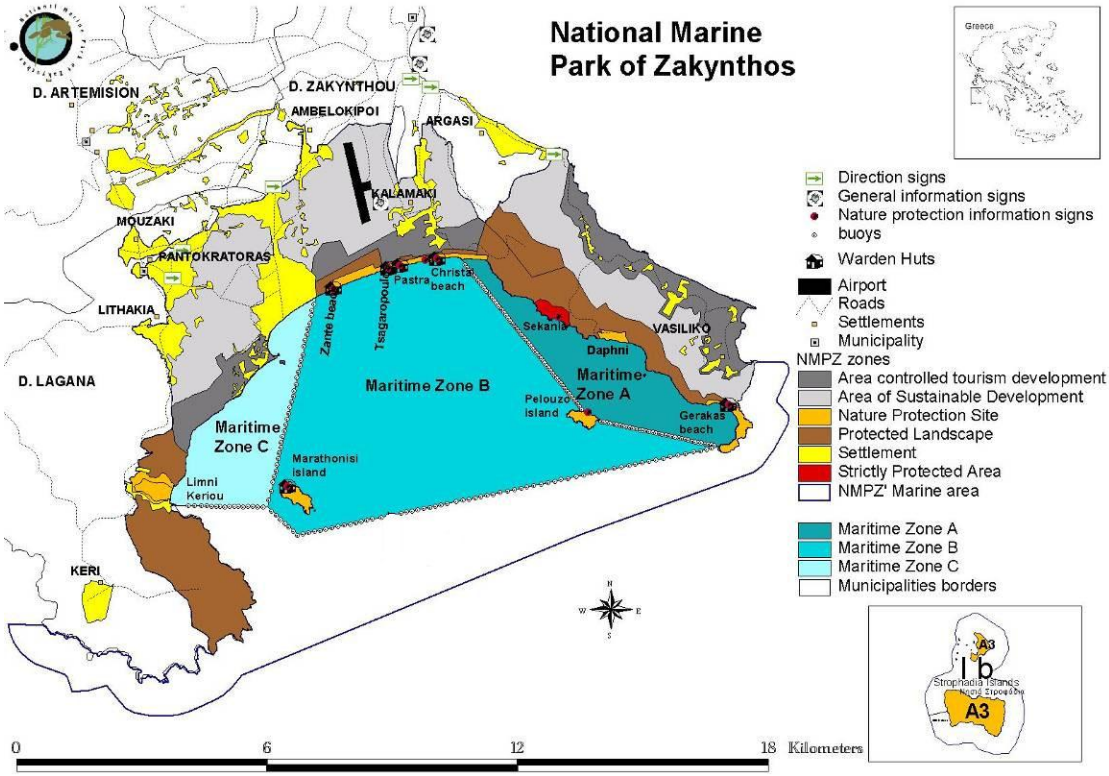

Figure 1. The study area of Laganas Bay, Zakynthos, Greece

Figure 2. Loggerhead sea turtle (*Caretta caretta*) with a tracking device

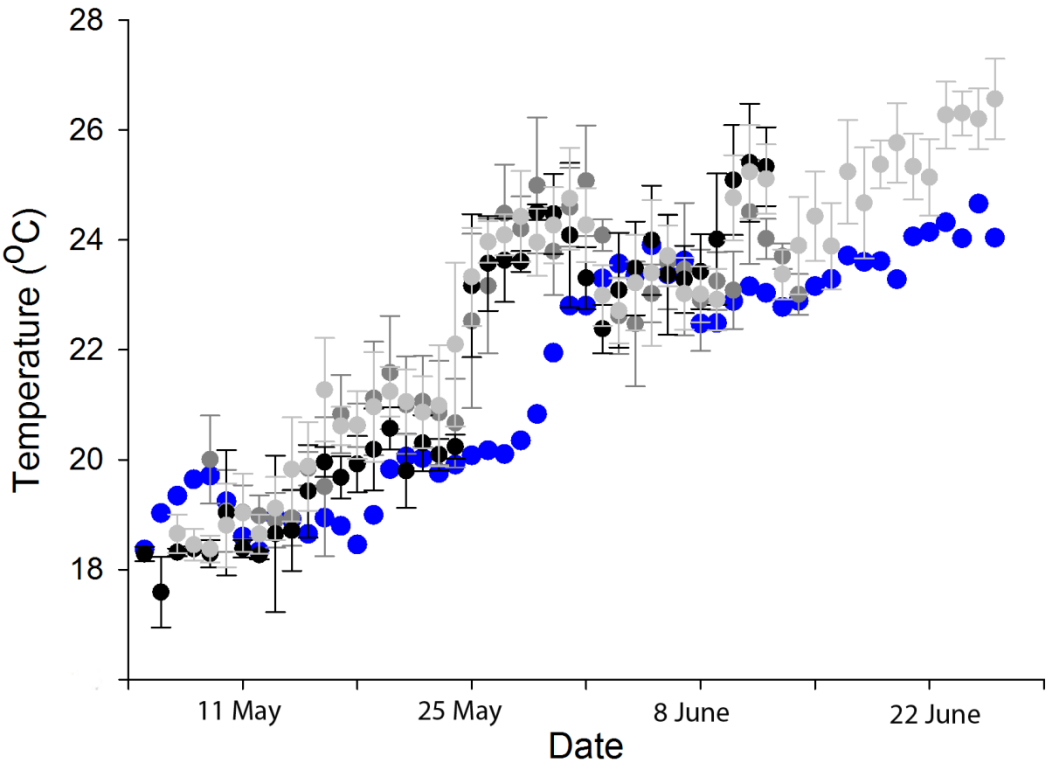

Figure 3. The mean daily surface sea temperature at 3 m depths (blue circles) versus the mean daily temperatures experienced by three female turtles with standard deviations.

Future collaboration with host institution (if applicable)

Because the data for one season indicates individual variation in thermal marine area use, I plan to assimilate all existing datasets of temperature and dive behaviour that I have obtained over the last four years. I will prepare these datasets over the following months. In addition I will combine GPS records, when present, to determine whether turtles are using shallow nearshore waters or the surface of deeper waters, in addition to ambient sea temperature records and weather datasets. Once this data is assimilated, I intend to return to Swansea University (March 2011) to design a biophysical model of how temperature drives reproductive output and hence predict the consequences of future temperature increases under the supervision of Professor Graeme C. Hays.

Projected publications/articles resulting or to result from the grant (ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant).
Based on the preliminary findings of the datasets, in collaboration with Professor Graeme C. Hays, I plan to produce at least one manuscript within 2-3 months following the completion of my second visit in March.

Other comments (if any)

I would like to thank the organisers of the Thermadap Grant for giving me the opportunity to collaborate with Professor Graeme Hays of Swansea University. I intend to pursue this collaboration, in order to utilise the expertise of the group to address fundamental ecological questions of thermal area use, which will contribute to the long term conservation efforts of the endangered loggerhead and possibly other marine reptiles.