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Consequences of Heatwave on Density of Freshwater Turtle Populations in Water Plans of Northeastern Algeria

Abdelaziz Frih [a*], Nadia Ziane [a], Kamelia Hesni Benotmane [b] and Rached Hadiby [c]

[a] Environmental Biomonitoring Laboratory, Department of Biology, Faculty of Sciences, Badji-Mokhtar University, 12 El Hadjar, 23000 Annaba, BP, Algeria.
[b] Laboratory of Soils and Sustainable Environment, Department of Biology, Faculty of Science, Chadli Bendjedid University BP 73, 36000, El Tarf, Algeria.
[c] Ecobiology Laboratory for Marine Environments and Coastal Areas, Faculty of Sciences, Badji Mokhtar Annaba University, BP 12, 23 200, Annaba, Algeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aquatic turtles are ectotherm animals whose activities are conditioned by their environment. The objective of this study is to asses the heatwave effects on the abundance of aquatic turtles. The resulting study was conducted from spring to fall 2022, in a water plan next to Guerbes Sanhadja wetlands eco complex, known for the density of aquatic turtles it hosts. Temperature and rainfall

**Corresponding author: Email: frihabdlaziz00@gmail.com, abdelaziz.frih@univ-annaba.org;*

data, as well as satellite images and field photography, were utilised to monitor the drying of the water plain. . Freshwater turtles were counted remotely every one hour from a specific location. The results obtained confirm the resumption of aquatic turtle activity, particularly marked in summer, but the persistence of heatwave, with abnormally high air temperatures and very low rainfall, caused the gradual drying up of the water plan and a sharp drop in turtle's numbers.

Keywords: Heatwave; freshwater turtles; abundance; loss of habitats.

1. INTRODUCTION

Freshwater ecosystems are remarkable habitats offering multiple ecological services in terms of hydrological properties, water resources and climate regulation [1] (Higgins et al., 2021). Due to human activities, freshwater ecosystems are under intense pressure (land use change, eutrophication, species invasion) [2,3]. Moreover, global warming has direct impact on the hydrological cycle and hence on the aquatic ecosystems [4,5]. These climatic conditions may cause irreversible damage to these ecosystems upon which huge biodiversity and ecosystem services are dependent [6]. Currently, the biodiversity of freshwater sites is declining and the rate of extinction of species is high [7,8]. This decline does not spare marsh turtles, which are particularly threatened [9,10]. Indeed, 30% of freshwater reptile species and 50% of turtle species are close to extinction [11]. Herpetofauna is still poorly known in Algeria, with just a few studies on the leper Emyde., (*Mauremys leprosa*), one of the two species of aquatic turtles present in the region of Annaba and National park of El Kala, with the Cistus of Europe, (*Emys orbicularis*) [12-17]. In this study, we were interested in the effect of the persistence of the heat wave on the abundance of aquatic turtle's population in a water plan known for their great density, which made it an attractive place for their observation.

2. MATERIALS AND METHODS

2.1 Study Area

Our study was carried out near to Guerbes Sanhadja wetlands eco complex (36°45'-37°1' N; 7°13'-7°30' E), which is a large littoral plain of 42,100 ha, bordered to the west by the Skikda coastal hills, and to the east by the coastal forest massif of Chétaïbi [18]. This wetland is important for bird's conservation in Algeria [19]. Among these water plans, we were interested in a small water plan bordering the CW57 road linking Annaba to LaMarsa. This water plan borders Oued Ennkouche which leads to Gaarat Ben Mahammed (Fig. 1).

This water plan is particularly interesting because residents and tourists come regularly to observe the aquatic turtles, very abundant from the spring season. The water plan has never dried up according to the temperature data of the last ten years and the observations of the residents (Fig. 2).

2.2 Methodology

The evolution of the water level was monitored, using satellite images by the ArcGIS 10.3 software. These data were supported by temperature and rainfall data from the study area over the last ten years; to demonstrate the exceptional nature of the heat wave during the summer 2022. Sampling campaign was conducted, at the rate of one trip per month, to identify account specimens. We have adopted a sampling strategy based on observations with binoculars (CARL ZEISS, 8 X 50), from a fixed observation point during one hour of time [16]. This survey is carried out in the morning and in sunny or cloudy weather (less than 40% coverage) (Fig. 3).

2.3 Data Analysis

The results are expressed as a standard error of mean. The graphical representation of the data was based on the development of histograms under Microsoft Office Excel 2007.

3. RESULTS

3.1 Satellite Images Analysis

The analysis of satellite images shows that in April 2022, the water level covers the entire surface of the water plan (4198 M^2). However, the satellite images collected in October 2022 show an almost complete drying of the water plan whose part covered by water covers only a surface of 28, 9 M^2 (Fig. 4; Fig 5).

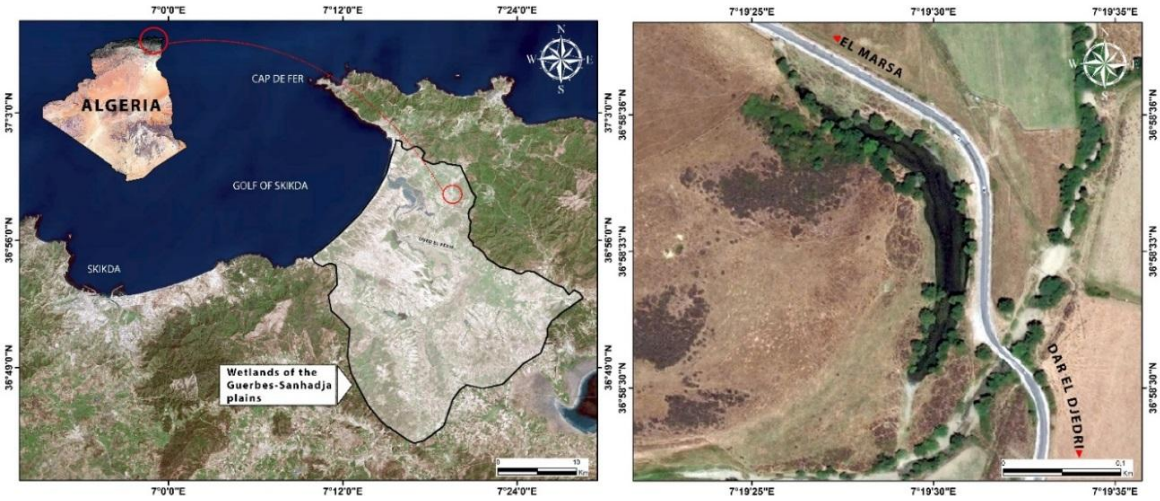

Fig. 1. Study area with localization of the water plan

Fig. 2. Temperature and rainfall data from the last ten years in Skikda province (national meteorological office)

Fig. 3. Aquatic turtles observed in the water plan during summer period

3.2 Relationship between Abundance of Aquatic Turtles and Meteorological Data

The results showed a seasonal variation in abundance based on temperature and rainfall data. Thus, we can see that the abundance of aquatic turtles decreases significantly with the installation of the heat wave, which is reflected by the increase of the temperature in summer and autumn, with a maximum temperature value of around 40°C, and the decrease in rainfall particularly marked in summer compared with spring (Fig. 6).

4. DISCUSSION

Freshwater turtles are poikilothermic animals, which spend several hours per day exposed to the sun in order to regulate their internal temperature. This activity called "basking" usually takes place during the activity period (late morning and early evening), when the outside temperature is optimal, according to their needs (on average 26°C) [20]. In this study, we follow the evolution of aquatic turtle's population abundances, in a water plan facing an exceptional heat wave, which caused a drying of almost all this habitat. In this water plan, aquatic turtles do not appear to be disturbed by nearby recreational activities and adapt perfectly to human presence. These same disturbances have been identified as a cause of population decline in other turtle species [21,22], which are highly sensitive to disturbances when they predate and nest [21,22]. Moreover, our results showed differences in aquatic turtle's abundances according to the seasons. During spring period, we recorded a lower strength of aquatic turtles than the summer period. This result is according to bibliography, which showed that aquatic turtles hibernate from October to March, and that activity period begins at the end of March [23,14]. In the end of summer, the persistence of the heat wave period, causing an almost complete drying of the water plan and a very significant decrease in aquatic turtles. Water plan turtles exploit a very wide range of aquatic habitats that enable them to complete their life cycle. However, heat waves caused by global warming and prolonged periods of drought, can affect densities and distribution of aquatic turtle populations (Le Treut, 2013), especially because of their a very low dispersal power [14]. Hassen *et al* [6] showed that the climate change can affect motile vs non-motile species differently, leading to change in species distribution. Thus, it is necessary to identify and monitor the meteorological factors that can influence the distribution and abundance of these species with limited mobility, in order to establish conservation and management mechanisms [24,25].

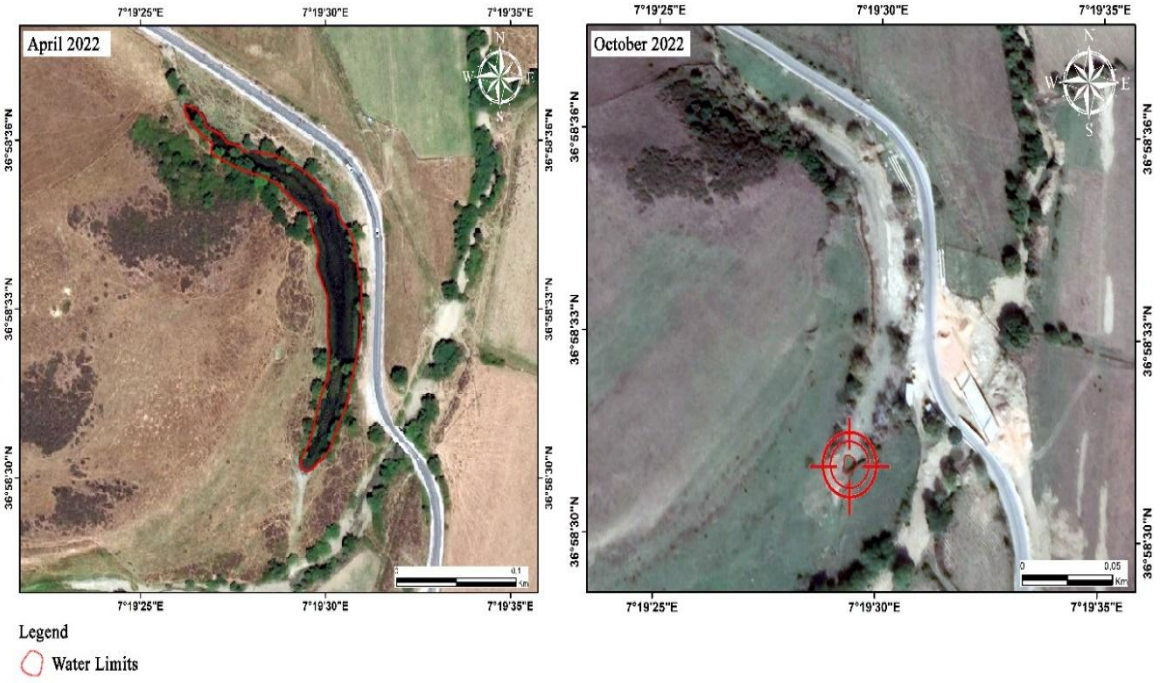

Fig. 4. Satellite images collected in April and October 2022

Fig. 5. Photos of the water level of the water plan during the months of April and October 2022 (Present work)

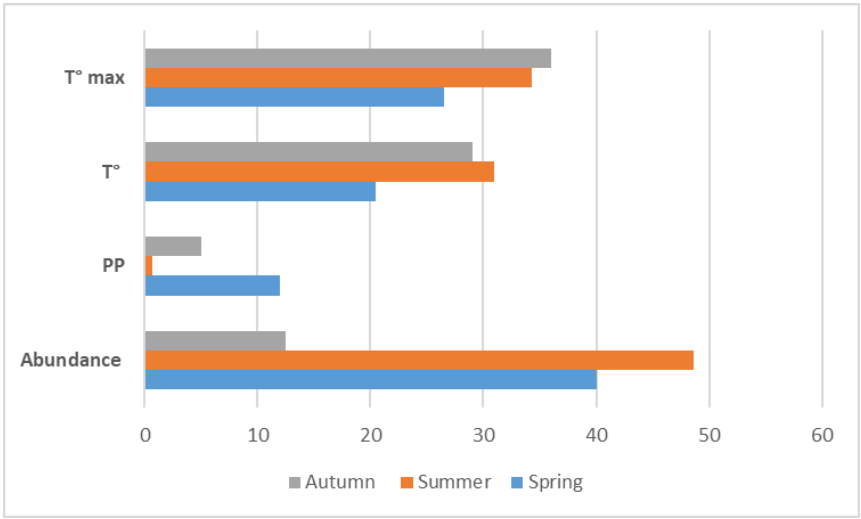

Fig. 6. Data of freshwater turtles abundances, maximal temperatures and rainfall during spring, summer and autumn periods in 2022

5. CONCLUSION

Monitoring of freshwater habitats is essential to conserve their ecological value. This study allowed us to deduce that the persistence of heatwave can cause a loss of habitat; which is very damageable to the density of natural populations of aquatic turtles, hence the need to set up actions of level water monitoring, to conserve and protect these species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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