

Impact of the wild boar *Sus scrofa* Linnaeus, 1758 (Mammalia Suidae) on wetlands soil quality: case of Black and Blue Lakes (National Parc of El Kala, northeastern Algeria)

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ABSTRACT

The wild boar *Sus scrofa* Linnaeus, 1758 (Mammalia Suidae) is one of the most prolific and invasive species threatening the balance of natural areas, particularly wetlands. The objective of this work is therefore to assess the impact of this species on the physical quality of soils in the wetlands of El Kala National Park. The study was conducted on the Blue and Black Lakes during and after the hunting season. The activity traces were geolocated and then overlaid on a map using the SasPlanet program. The results obtained show overall a limited activity of the wild boar in the Black Lake. However, there is a significant increase in the rooted area of the Blue Lake, which is particularly marked after the hunting period, but this seems to be the result of the decrease in the water level.

KEY WORDS

Sus scrofa; wetlands; hunting period; National Park of El Kala.

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INTRODUCTION

Wetlands are natural reserves of biodiversity that are currently undergoing major disturbances (Raachi, 2007; Vallée, 2016). In addition to the anthropogenic pressure induced by the requirements of economic growth and human activities (agriculture, pollution, overexploitation of resources) (Guedegbe, 2008; Adamjy et al., 2020), wetlands are faced with the spread of invasive species that directly affect native species and can influence changes in ecosystems through multiple disturbances (Clavero & Garcia-Berthou, 2005; Risch et

al., 2021). Among these species, the wild boar *Sus scrofa* Linnaeus, 1758 (Mammalia Suidae) occupies a special place, insofar as it is among the 100 worst invasive alien species in the world, constituting a direct threat to more than 672 taxa in 54 different countries around the world (Lewis et al., 2019; Risch et al., 2020, 2021). The regulation of natural wild boar populations is currently dependent on hunting, because humans are the main predator of this species, after the disappearance of super predators (Boumendjel et al., 2016; Daucourt & Gaudy, 2018). This is also the reason that has led scientists to carry out numerous impact studies to monitor and

even evaluate its effects at several levels on biodiversity and ecosystem services in wetlands (Tolon & Baubet, 2010; Delorme et al., 2012; Darinot, 2014). The objective of this study is to make a monitoring of wild boar in some wetlands in the north-east of Algeria. We chose two emblematic lakes of the complex of wetlands in the national park of El Kala, where we tried to identify the activity indices of the species to evaluate the impact exerted in soil.

MATERIAL AND METHODS

Study area

The study was carried out in the National Park of El Kala (PNEK) located at the extreme north-eastern Algeria (36°50' N - 8°27' E) (Fig. 1). We conducted two sampling campaigns with two outings per campaign, during and after the regulated wild boar hunting period 2022, which takes place each year between September 15 and January 30. We conducted a prospecting campaign in two lakes: the Blue and the Black Lakes for their small area and

their great accessibility, which allowed us to do a complete prospection.

The Blue Lake is located in an interdune zone to the northeast of Mellah Lake. It is a depression probably resulting from a drying up of the great Lake Mellah. The depth of this lake is estimated between 10 to 35 meters (Cheriak, 1993; Mekki, 1998; Samraoui & de Belair, 1998; Djaaboub, 2008.). Four vegetation belts characterize the vegetation of the Blue lake: the first is made up of aquatic plants where we find the water lilies *Nymphaea alba* L. and *Callitriche stagnalis* Scop. The second is the semi-aquatic plants *Typha angustifolia* L., *Cladium mariscus* Pohl, *Iris pseudacorus* L. The third belt is the semi-terrestrial plants where we find the *Salix alba*. The fourth belt is the Aulnaie where we find the *Pistacia lentiscus* L., *Salix pedicellata* Desf., *Lavandula stoechas* L.

The Black Lake peatland is located in the north-east of Algeria, in the wetland complex of El Kala. It is an old lake dried up accidentally. Since then, only the underlying bog remains, which today replaces the old lake. It has an area of 5 hectares, and a shallow depth (maximum of 1.5 meters). Indeed, this body of water can completely dry out during warm periods.

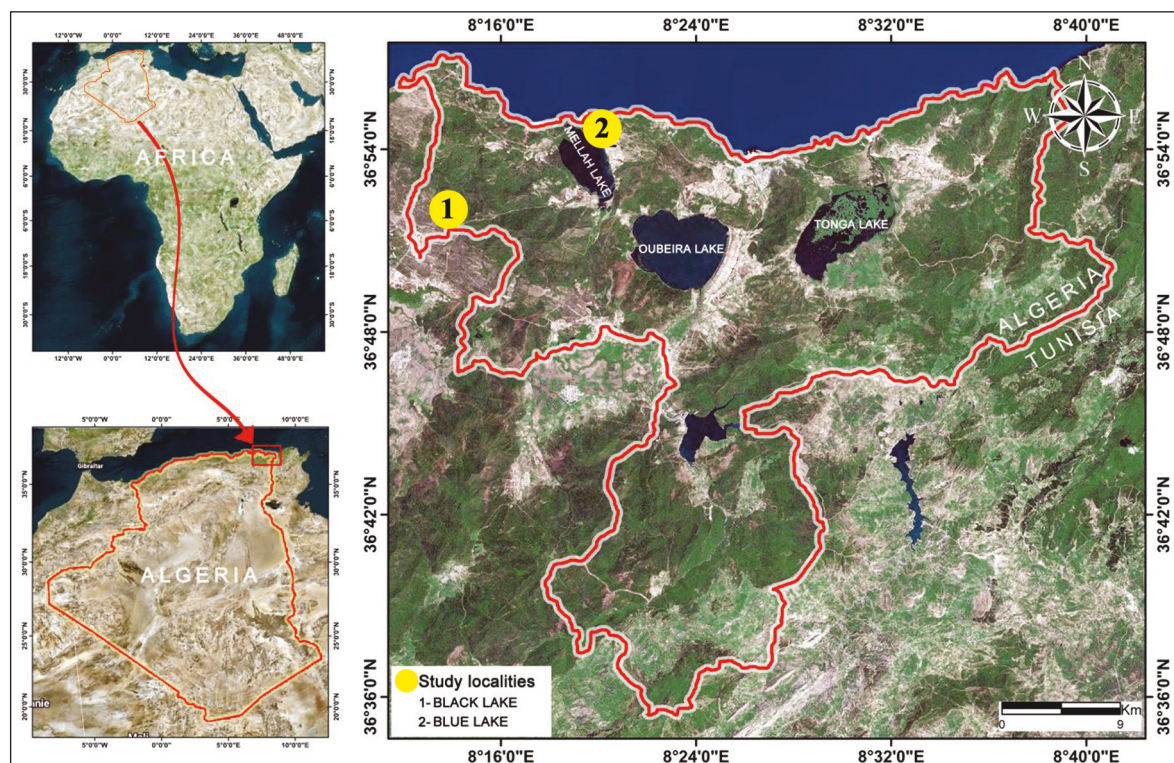


Figure 1. Study area with sampling sites: 1 = Black Lake, 2 = Blue Lake.

Methodology

The complete survey carried out at the two lakes enabled us to map the traces of wild boar activity in November and December 2021 (during hunting) and in February and March 2022 (after hunting has closed). Each root has been geolocated, and the damage on the ground was mapped according to 5 intensity classes (according to Darinot, 2014):

- Intact areas.
- Areas with buttes spaced more than 10 meters apart.
- Areas where buttes are spaced 2 to 10 meters apart.
- Areas where buttes are spaced less than 2 meters apart.
- Total soil pickled areas.

All spatial land cover analysis and distribution data for waterbird functional groups have been conducted using the software ArcGIS 10.3 software.

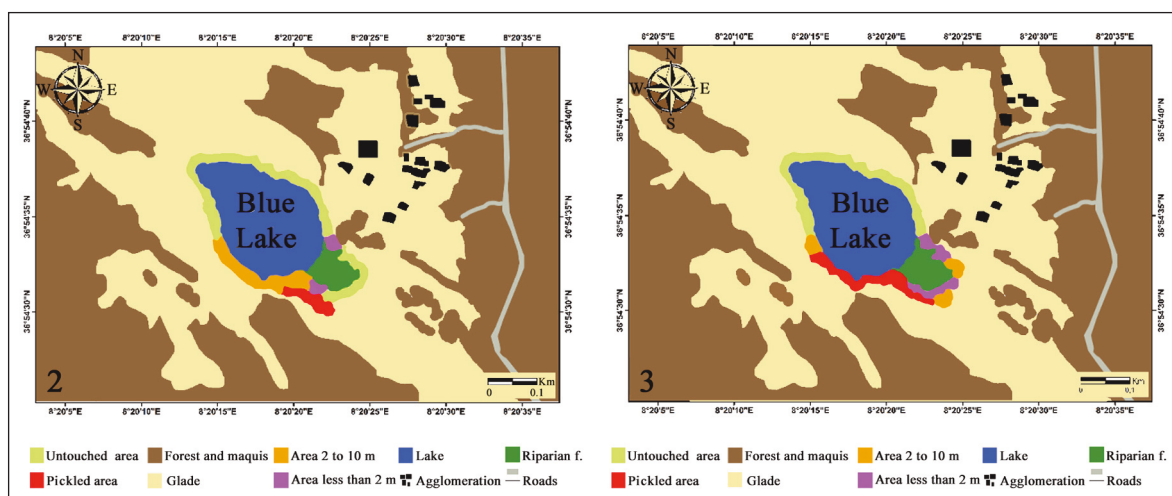
RESULTS

Impact of wild boar in Blue Lake

The results show an unequal distribution of soil traces, with intact areas on the side of cultivated fields surrounded by fences, and areas with traces of more or less intense activity. These areas are mainly located on the emergence side of the Royal Fern, and near the belt of bulbous plants that surround the lake in part of its southern shore. The results also showed that hunting does not seem to affect wild boar activity on the ground,

Soil Trace activity Period	Untouched area	Area 2 to 10 m	Area less than 2 m	Pickled area
During the hunting season	0.97 ha	0.35 ha	0.07 ha	0.12 ha
After hunting season	0.68 ha	0.18 ha	0.29 ha	0.36 ha

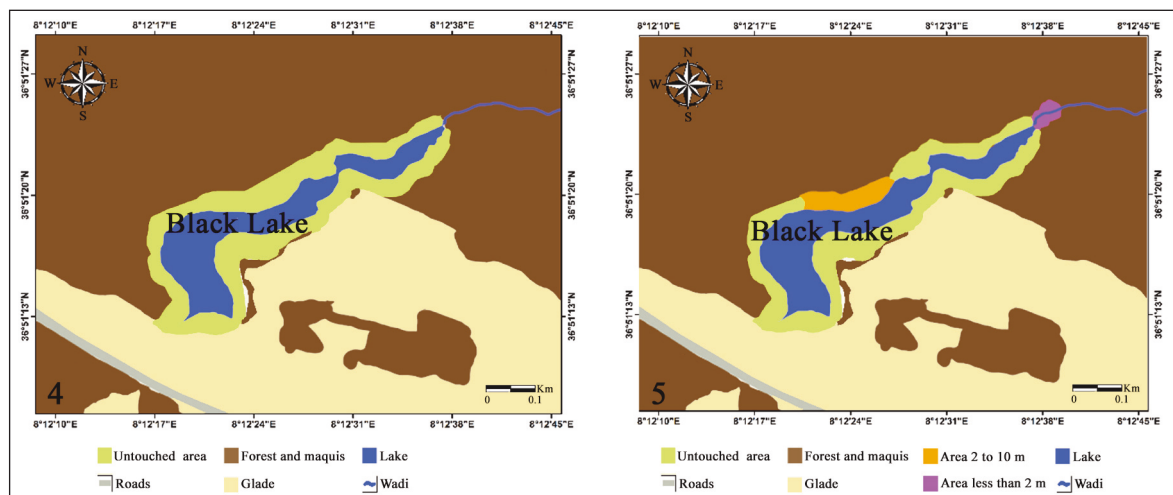
Table 1. Calculation of Pickled surface in the Blue Lake (Sasplanet).



Figures 2, 3. Rooting zone map during and after the Blue Lake hunting period. Fig. 2: damage on soil during the hunting period. Fig. 3: damage on soil after the hunting period.

Soil Trace activity Period	Untouched area	Area 2 to 10 m	Area less than 2 m	Pickled area
During hunting season	2.44 ha	0.34 ha	0.11 ha	0
After hunting season	2.89 ha	0	0	0

Table 2. Calculation of Pickled surface int Black Lake (Sasplanet).



Figures 4, 5. Map of the rooting zone during and after the hunting period at Black Lake. Fig. 4: damage map on the ground during the hunting period at Black Lake. Fig. 5: damage map on the ground after the hunting period.

since the Pickled area are identical (Table 1; Figs. 2, 3).

However, we observed that the activity of the species is more dependent on the withdrawal of the water level allowing a better accessibility for the species to the belt of bulbous plants *Iris pseudacorus* (personal observations).

Impact of wild boar in Black Lake Peatland

The results obtained show a total absence of traces of activity during the hunting period, despite the increase in numbers reported by the residents found around the lake. After hunting period, we found a very reduced activity, which is limited to the north east shore of the lake, located near a cork oak forest, rich by definition in oak acorns, aerial herbaceous plants as well as underground herbaceous

plants. Finally, we found that pickled area is characterized by moist soil rich in earthworm, which could explain the presence of the species for watering, grooming and feeding purposes (Table 2; Figs. 4, 5).

DISCUSSION

The results obtained at Blue Lake showed more traces of ground activity after the hunting period with completely stripped areas at the level of the plants with bulbous and certain rares plants like the royal fern. Numerous studies have shown that soil inversion by wild boar creates clumps that modify the edaphic and hydrological properties (Browning, 2008; Pitta-Osses et al., 2020), accelerates decomposition and changes soil nutrient concentrations (Wirthner et al., 2012) facilitating soil erosion

(Baltzinger, 2007; Massei et al., 2004). In addition to their direct impacts on fauna and flora, wild boars are generally known to disturb the structure of the ecosystem, due to their unique rooting and digging behavior. This activity induces changes in plant structure (Doupé et al., 2010) which could lead to the disappearance of several rare species (Brown, 2014) especially in wetlands that provide increasingly threatened habitats for several plant species (Brown, 2014; Risch et al., 2021). In the case of the Black Lake, the peatlands are reputed to be ecosystems with high levels of biodiversity (Brown, 2014). If the activity of the wild boar is very restricted at this site, many works incriminate it in the disturbance, see the destruction of peatlands (Brown, 2014). Indeed, the wild boar particularly likes this environment, in search of its food (bulbous plants or earthworms), but also to regulate its temperature or to heal itself in case of injury, or parasites (Cabanau, 2007; Daucourt & Gaudy, 2018). We suppose that the forest overlooking the Black Lake plays an essential role in maintaining the integrity of this site, since the wild boar, a typically forest species, finds all the trophic resources it needs.

CONCLUSIONS

The results obtained showed a direct effect in Blue and Black Lakes soil, even if traces of activity remain more or less restricted. Nevertheless, this preliminary study has allowed to apply a method for estimating the impact of wild boar on the ground in the wetlands of El Kala National Park.

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