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Vitória Margarida Ribeiro Fontora

O javali e os agricultores: a importância da dimensão humana na resolução de um caso de conflito

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Ecologia Aplicada, realizada sob a orientação científica do Doutor Mário Jorge Verde Pereira, Professor Auxiliar do Departamento de Biologia da Universidade de Aveiro e do Doutor Ulisses Manuel de Miranda Azeiteiro, Professor Associado com Agregação do Departamento de Biologia da Universidade de Aveiro.

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Presidente	Prof. Doutora Maria Helena Abreu Silva, Professora Auxiliar, Departamento de Biologia, Universidade de Aveiro
Vogal – Arguente	Prof. Doutora Edna Carla Janeiro Cabecinha da Câmara Sampaio, Professora Auxiliar, Departamento de Biologia e Ambiente, Escola de Ciências da Vida e Ambiente, Universidade de Trás-os-Montes e Alto Douro
Vogal – Orientador	Prof. Doutor Mário Jorge Verde Pereira, Professor Auxiliar, Departamento de Biologia, Universidade de Aveiro

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palavras-chave

Conhecimento ecológico local; Atitudes; *Sus scrofa*; Conflito Homem-Javali; Gestão de Vida Selvagem

Resumo

Os elevados números populacionais do javali (*Sus scrofa*) têm levado ao surgimento de variados casos de conflito com o ser humano em todo o mundo. Assim, de maneira a procurar uma solução para o problema, têm surgido e sido aplicadas diversas medidas de gestão populacional: caça, uso de cercas, aplicação de tóxicos, colocação de armadilhas, alimentação suplementar, vacinação e contraceção. No entanto, nenhuma dela é totalmente eficaz e capaz de pôr um fim ao problema. Deste modo, a etnobiologia e conhecimento ecológico local (CEL) foram usados como ferramenta de auxílio à criação de planos de gestão do javali realistas e exequíveis. Para tal, foram realizadas 41 entrevistas semiestruturadas a agricultores de uma aldeia de Viseu, com o objetivo de recolher o seu CEL e as suas atitudes em relação aos planos de gestão e de conservação do javali. Verificou-se que há um vazio de informação em tópicos como a existência de predadores, o funcionamento da caça ao javali e o seu estado de conservação. Quanto às atitudes de conservação, a grande maioria vê o javali como um problema e uma fonte de despesas, opondo-se à sua conservação e apoiando o seu extermínio. Com tudo isto em mente, foi proposto um plano multidisciplinar e flexível, com capacidade de se moldar às diferentes necessidades dos diferentes *stakeholders* de diferentes localidades. Paralelamente, foi ainda proposto a criação de organizações locais responsáveis pelo apoio à população afetada pelo conflito. Para combater a desinformação, tudo isto deve ser acompanhado por um reforço na educação e sensibilização da população local.

Keywords

Local Ecological Knowledge; Attitudes; *Sus scrofa*; Human-Wild Boar conflict; Wildlife Management

Abstract

The high population numbers of wild boar (*Sus scrofa*) have led to the emergence of several cases of conflict with humans around the world. Thus, in order to seek a solution to the problem, several population management measures have emerged and been applied: hunting, fencing, application of toxins, trapping, supplementary feeding, vaccination, and contraception. However, none of them is fully effective and capable of ending the problem. Thus, ethnobiology and local ecological knowledge (LEK) were used as a tool to help create realistic and achievable wild boar management plans. To this end, 41 semi-structured interviews were conducted with farmers from a village in Viseu, in order to collect their LEK and their attitudes towards wild boar management and conservation plans. It was found that there is an information gap on topics such as the existence of predators, the operation of wild boar hunting and its conservation status. As for conservation attitudes, the vast majority see the wild boar as a problem and a source of expense, opposing its conservation and supporting its extermination. With all this in mind, a multidisciplinary and flexible plan was proposed, with the ability to mold itself to the different needs of different stakeholders in different locations. In parallel, the creation of local organizations responsible for supporting the population affected by the conflict was also proposed. In order to combat misinformation, all of this must be accompanied by a strengthening in the education and awareness of the local population.

Contents

Figure Contents

Table Contents

Introduction

Human-wildlife conflict continues to escalate in many parts of the world, with adverse consequences for both animals and humans. In addition, this conflict has intensified in recent years, driven, among other reasons, by the expansion of human populations into wildlife habitats and, at the same time, by the recolonization by animal species of portions of their former habitat (Skogen et al., 2008; Woodroffe et al., 2005). This conflict can be defined as "situations occurring when an action by either humans or wildlife has an adverse effect on the other" (Conover, 2002) and a flagrant example that can be found globally is the case of the wild boar (*Sus scrofa* Linnaeus, 1758).

The wild boar is present in almost all continents, thus being one of the terrestrial mammals with the largest geographical distribution in the world (Oliver et al., 1993). Despite having been threatened and even extinct in some areas due to overhunting, habitat fragmentation, habitat destruction, among others, populations have managed to recover and reach the distribution they currently have (Goulding, 2000; Rosell et al., 2001). This expansion has been accompanied by an increase in population numbers and it is a consensus in scientific circles that, in Europe, wild boar numbers have increased over the last 30 years (Tack, 2018). In addition to this, it is also a species with high ecological plasticity, with the ability to live in varied habitats and at different temperatures and with an opportunistic and generalist diet (Heptner et al., 1988; Schley & Roper, 2003).

So, in view of all this, it is easily understandable how and why this species often comes into conflict with humans. Indeed, the presence of wild boar can be harmful to human and animal health, agriculture and biodiversity: wild boars have the ability to act as reservoirs of diseases and infectious parasites dangerous to both livestock and humans (Jansen et al., 2007; Rossi et al., 2011); furthermore, these ungulates can cause extensive damage to agriculture by consuming and/or destroying crops through rooting, digging and trampling (Seward et al. 2004); finally, terrestrial and aquatic habitats are also affected by rooting, which causes, among others, losses in soil nutrients, acceleration of leaf litter decomposition (Singer et al., 1984), destruction of aquatic vegetation or the production of algal blooms (Kaller & Kelso, 2006).

Due to all this, the wild boar has become a highly problematic species, and has even been included in the IUCN list of the 100 "World's Worst Invaders" (Lowe et al., 2004). Thus, mitigation measures to control wild boar populations and reduce the damage caused by it in an effective and lasting way are essential. Currently, there are already a myriad of different damage management techniques possible to use on wild boar, which can be lethal (hunting, trapping, or poisoning) or non-lethal (fencing, supplementary

feeding, vaccination,or contraception) (West et. al, 2009). Hunting is considered one of the most effective methods for population control, however, it has to be intensive and consistent in order to be effective (Beskardes et al., 2010; West et al., 2009). Similarly, the use of traps is also one of the most popular methods, since traps are generally cheap and simple to implement (Mayer & Brisbin, 2009). As for non-lethal methods, it is worth mentioning that the use of fences can be a great method to apply around high value areas, but they usually require a high initial and maintenance investment (Mayer & Brisbin, 2009). So, as can be seen, none of the methods is infallible: complex problems require complex solutions. Thus, several authors have suggested the use of integrated management approaches (Monaco et al., 2010; Massei et al., 2011): the combination of different prevention and reduction methods at the same time in order to optimize results (United States Department of Agriculture - USDA, 2002).

However, even when applying and following these solutions, wildlife managers rarely achieve a long-term resolution of the conflict: applying the measures without listening to the affected audience is not effective (Marker, 2002; Webber et al., 2007). Indeed, the causes of conflict are usually complex and quite deep-rooted, and can be influenced by, for example, the perception of the risk that the species represents to the population, the occurrence of disproportionate responses and/or social influences (Dickman, 2010). It is crucial to consider the different cultural, economic, emotional, spiritual, mental, and social values of different audiences, which may even be different and contrasting between the same audience (Decker et al, 2012; Woodroffe et al. 2005) - where managers have dismissed the importance of listening to and implementing these values in their management plans, their implementation has only led to increased conflict (Bronner, 2008; Dandy et al., 2011; Green et al. 1997). It is therefore advised that wildlife managers collect, through interviews or public meetings, opinions and attitudes towards conservation, as well as knowledge provided by the affected public, in order to create plans that consider socio-economic and cultural contexts, and not just the ecological one (Dickman, 2010; Frank et al., 2015). The knowledge retained and shared by the local population can be referred to as local ecological knowledge (LEK) and concerns any lay or experiential knowledge about the environment and that has been obtained through observations, practical contact or acquired scientific knowledge and that is passed down over generations (Berkes et al., 2000; Yli-Pelkonen & Kohl, 2005).

In Portugal, the wild boar is found throughout the national territory, only absent from large urban centres or certain coastal areas (Fonseca, 2004), and has had a population increase since 1980 (Bosch et al., 2012; Massei et al., 2014;). It is possible to

carry out actions to control the species resorting to hunting, which is allowed under certain conditions (Decree-Law No. 202/2004 of 18 August of the Ministry of Agriculture, Rural Development and Fisheries, 2004) (Instituto da Conservação da Natureza e das Florestas - ICNF, 2020), but the conflict remains. Thus, taking all this into account and considering that the public identifies damage as the main cause for conflict to occur (Sillero-Zubiri & Laurenson, 2001), the aim of this study is to, using semi-structured interviews, assess 1) the LEK and 2) the opinions, feelings, and attitudes towards conservation of the public that is most affected by the damage caused by wild boar: farmers. In this way, it will be possible to contribute to more comprehensive and interdisciplinary management plans for wild boar populations in Portugal.

From the Wild Boar to the Local Ecological Knowledge

To help more easily understand the subject matter of the thesis, it will be detailed in the following sections the pillars of the work. Thus, it will be talked about the biology and natural history of the wild boar, its impact, and consequent forms of conflict with humans, the solutions and management techniques used to combat this conflict and, finally, the Importance of the human dimension in Human-Wild Boar conflict and how it can be used as a weapon to combat it.

1. Biology & Natural History of the Wild Boar

i) Taxonomy

The wild boar (*Sus scrofa*), also known as Eurasian Wild Pig, is one of the mammals most closely related to the human species since prehistory. It belongs to the Suidae family, which in turn is part of the Cetartiodactyla order and represents the genetic origin of today's domestic pigs (Keuling & Leus, 2019; Rosell et al., 2001). This species has been divided into 16 subspecies (Wozencraft, 2005): *Sus scrofa algira; Sus scrofa attila; Sus scrofa cristatus; Sus scrofa scrofa; Sus scrofa davidi; Sus scrofa leucomystax; Sus scrofa libycus; Sus scrofa majori; Sus scrofa meridionalis; Sus scrofa moupinensis; Sus scrofa nigripes; Sus scrofa riukiuanus; Sus scrofa sibiricus; Sus scrofa taivanus; Sus scrofa ussuricus and Sus scrofa vittatus.* The subspecies that occurs in Portugal is *Sus scrofa scrofa*. Currently it is considered by IUCN Red List of Threatened Species as Least Concern (LC) due to its “wide range, abundance, tolerance to habitat disturbance, and presence in many protected areas” (Keuling & Leus, 2019).

ii) Geographic Range

The wild boar is one of the world's most geographically distributed land mammals (Oliver et al., 1993), occurring from America and Oceania (where it was introduced) to Europe, Africa and Asia (Keuling & Leus, 2019; Lewis et al., 2017; Mayer & Brisbin, 2009; Salvador & Fernandez, 2017; Sjarmidi & Gerard, 1988). It originates from Southeast Asia (Chen et al., 2007) and in Europe it is present in all continental areas with the exception of northern Fennoscandia and European Russia (Keuling & Leus, 2019). It has already been extinct in areas such as Scandinavia (Welander, 1995), the United Kingdom (Clutton-Brock, 1996), and parts of North Africa due to various factors (over-hunting, fragmentation

and habitat destruction, incompatibility with intensive farming, among others) (Rosell et al., 2001). Thanks to changes in land use, the re-colonisation and introduction of individuals has been viable, and the recovery of these populations was possible (Goulding, 2000). In Portugal, it occurs all over the continental territory, being only absent from major urban centres and from certain parts of the coastal belt (Fonseca, 2004). However, as in other parts of Europe, it also suffered a drastic reduction in the beginning of the 20th century and was even declared an "In Danger" species, only later slowly recovering until it reached its present distribution (Bencatel et al., 2019)

iii) Population

Regarding estimates of population trends, although the numbers are generally high, there are no studies that give us an exact figure, either globally or at European level (Keuling & Leus, 2019) - wild boar, due to their nocturnal activity (Lemel et al. 2003), intensive reproduction, long migrations and feeding behaviour, are a difficult species to develop accurate population estimates for (Tack, 2018). However, as mentioned above, there is a consensus among scientists that the number of wild boar in Europe has grown over the last 30 years (Tack, 2018), although recently population growth seems to have slowed down (Keuling & Leus, 2019). As for Portugal, two recent studies aimed at assessing the abundance and density of wild boar in Portuguese territory, using hunting bags: as expected, the population has increased since 1980 (Massei et al., 2014), with a population density of 0.31 per km^2 in 2007 (Bosch et al., 2012).

iv) Morphology

The wild boar is a short trunk but massive animal, with legs and short neck, the latter almost immobile, and small eyes (Mayer & Brisbin, 2009). The head occupies a third of the body length (Heptner et al., 1988) and is adapted to facilitate digging, functioning as a plough (Marsan & Mattioli, 2013). The tail is covered in fur and is short, it can be straight or curled (Mayer & Brisbin, 2009). The canine teeth are well developed and are characteristic of the species, growing throughout its life (Tack, 2018), being used not only for defence, but also for markings and in fights for females (Rosell et al., 2001). The coat is usually brownish/black, with white or tan distal tips on the bristles, black at the extremities of the body and grey hairs around the snout (Mayer & Brisbin, 2009; Rosell et al., 2001; West et al., 2009), being longer along the back (Tack, 2018) – however, this species may present several colours or colour combinations (West et al., 2009). From

birth to 6 months, the cubs have a reddish-brown or yellowish colour with 11 longitudinal darker lines on the sides and back (Heptner et al., 1988), which should act as a camouflage (Mayer & Brisbin, 2009). The species has a very pronounced sexual dimorphism, the males being 5% to 10% bigger and 20% to 30% heavier than the females, with bigger canines, a well-developed dorsal mane and a subcutaneous tissue lining that develops during the mating season and serves as protection (Marsan & Mattioli, 2013; Rosell et al., 2001; Tack, 2018). The size of individuals varies according to the latitude and food available, being about 70-75 kg for females and 95-100 kg for males, and in certain European populations males can reach up to 270kg, measuring 110-118 cm in shoulder height (Mayer & Brisbin, 2009; Tack, 2018). At the sensory level, the most developed sense is the sense of smell, which is used not only for exploration but also for intra-species communication and defence (Rosell et al., 2001). Hearing is also highly developed and is used for communication and distinction between different calls (contact calls, alarm calls and combat calls) (Cabanau, 2001). Finally, the vision is quite weak, especially at long distances (Heptner et al., 1988).

v) Habitat and Ecology

The wild boar is an animal capable of living in various habitats and temperatures (Heptner et al., 1988). It can be found from semi-arid environments to swamps or from forests and alpine meadows 2400 metres tall to humid tropical forests (Sjarmidi & Gerard, 1988) - to survive, the wild boar needs only 3 conditions: areas of intense scrub (where they have a hiding place from predators), water (to drink and in which they bathe) and absence of regular snowfalls (Marsan & Mattioli, 2013; Tack, 2018). In addition, it is also important to have abundant and diverse food sources (Keuling & Leus, 2019). Thus, in Europe, this species prefers, according to the IUCN Red List of Threatened Species, "deciduous and mixed forests, preferably forests composed of oak and beech enclosing marshes and meadows". In addition, and precisely because they have great flexibility in living in different habitat types, they can also be found in highly humanized agricultural environments or even on the periphery of urban areas (Rosell et al., 2001).

This species is opportunistic and generalist, and its diet is mostly defined by food availability, which can vary between seasons, geographies and due to human causes (Schley & Roper, 2003). However, stomach and faecal content analyses tell us that 90% of the diet consists of vegetable food, which can be divided in 4 categories: mast, roots, green plant matter and agricultural crops (Heptner et al., 1988; Schley & Roper, 2003;

Spitz, 1986). In addition, insects, worms, molluscs, crabs and other arthropods are also common, as are invertebrates and small vertebrates such as new-born deer fawns, leporids and galliform chicks (Marsan & Mattioli, 2013; Schley & Roper, 2003). Being opportunistic, it is also common for these animals to resort to crops such as artichoke, maize, mustard, potato and rapeseed (Heptner et al., 1988).

This species is usually more active in the early hours of the morning or during twilight, although it can also exhibit nocturnal activity in areas with a considerable disturbance (Keuling & Leus, 2019; Podgórski et al., 2013). They are active for about 12 hours a day, and from these, 4 to 8 hours are spent looking for food or moving to the feeding areas. In addition, feeding is generally a social activity, in which even solitary males participate (Beuerle, 1975). Wild boars are therefore gregarious animals, forming herds or sounders. These herds can vary in size, depending on the geography and season, but usually have between 3 and 9 individuals and are dominated by matriarchs, thus consisting of interrelated females and their young (Barrett, 1978; Keuling & Leus, 2019; Tack, 2018). Male boars leave the herd between 8 and 15 months of age, sometimes forming small groups of sub-adult males, with females either remaining with their mothers or establishing territories close to those of their mothers with their sisters (Marsan & Mattioli, 2013). Adult males are usually solitary, only looking for females during the mating season (Marsan & Mattioli, 2013). It is easy to see that the social structure is then dynamic, with the greatest variability in the composition of the herd occurring during the mating season, where there are more fights between males and more births (Rosell et al., 2001). This area is usually divided into central areas, where the animals have their bedding, and peripheral areas, which are used infrequently and only when in search of certain food resources (Boitani et al., 1994).

The breeding season and habits of this species vary with the different subspecies and populations, with some, for example, breeding all year round and others only seasonally (Mayer & Brisbin, 2009; Tack, 2018; West et al., 2009). So, for the sake of simplicity, this work will be focused on what happens in European populations, and it can and will vary if we focus on other populations. So, in European populations, the wild boar is a seasonal breeder: the availability of food and the reduction in the length of the day triggers testosterone production and sexual activity - this reaches its peak in October and November (Keuling & Leus, 2019; Tack, 2018). It is then at this time that solitary males seek out the female groups and when fights occur between males for a female: the dominant male, usually the largest and/or the oldest, mates with the female more often

(Heptner et al., 1988). Thus, estrus begins with the arrival of autumn and lasts until mid-summer (Tack, 2018), taking between 48 and 72 hours (Barrett, 1978), occurring again in a 21-day cycle if the female is not successfully bred (Sweeney et al., 2003). The birth period occurs between March and May, peaking in April and the pregnancy lasts about 115 days (Tack, 2018). A few days before the birth, the female leaves the group and dedicates herself to the construction of a nest, with herbaceous or woody materials that guarantee thermal insulation, as well as some protection, where she will give birth (Rosell et al., 2001). The birth itself (parturition) lasts between two to three hours and a litter may contain between 4 to 6 piglets, which stay with the mother close to the nest for the first 4 to 6 days after birth (Heptner et al., 1988). The high reproductive capacity of this species is due to multiple factors: premature sexual maturity, short gestation period, high number of offspring and low natural mortality rates (Rosell et al., 2001; West et al., 2009). When the female and the piglets return to their herds, the piglets feed on mother's milk until they are 3 and a half months old, although they already started eating solid food such as worms and larvae from two weeks onwards (Tack, 2018). That said, from about mid-summer to autumn, the females become anoestrus and the 21-day cycle begins again in autumn (Rosell et al., 2001; Tack, 2018). Females reach sexual maturity at around 12 months of age, depending on food availability (Tack, 2018). Although males also attain sexual maturity when they are 10-12 months old, they are only able to compete for females and reproduce until they are 24 months old (Mauget & Pepin, 1985; Rosell et al., 2001). Unlike females, males are able to breed throughout the year (Mayer & Brisbin, 2009). This species can live up to a maximum of 10 to 14 years in the wild, although few exceed 5 years (Marsan & Mattioli, 2013).

vi) Threats & Conservation Actions

Lastly, it’s time to talk about threats. In Europe, the wild boar can suffer attacks from lynxes, bears and wolves, the grey wolf (*Canis lupus*) being the main predator: one single wolf can kill up to 80 wild boars per year (Heptner et al., 1988). However, this number is relatively low considering that, in Poland, the number of wild boars killed by hunters is up to 7 times higher than the number of wild boars killed by wolves (Jedrzejewski et al., 2000). This hunting can take place for several reasons: for food, for sport or for retaliation, being one of the greatest threats that the wild boar has to face today, together with habitat loss (Keuling & Leus, 2019). In addition to these, other causes of mortality can be mentioned: drowning in canals, starvation due to extreme weather conditions and road

accidents (Massei et al., 1997; Rosell et al., 2001). Lastly, the occurrence of infectious diseases that can lead to the decimation of entire populations (Keuling & Leus, 2019) should also be mentioned: Hepatitis E, African swine fever or classical swine fever (Tack, 2018). Thus, despite all these threats, and as far as I have been able to ascertain, there are no concrete measures in any of the countries where the wild boar is found to conserve this species, with the exception only of those practices that are carried out in such a way as to maintain the population numbers for hunting (Keuling & Leus, 2019; Rosell et al., 2001).

2. Impact of Wild Boar: Human-Wild Boar Conflict

As we have seen, wild boar populations are not only widely distributed, but also stable and well established, with high population numbers. This and its high ecological plasticity contribute to the presence of this animal negatively impacting the environment around it, leading to the emergence of cases of conflict with humans (Massei et al., 2014). This conflict, i.e. the conflict between humans and wildlife, can be defined as "situations occurring when an action by either humans or wildlife has an adverse effect on the other" (Conover, 2002). In this case, the conflict with the wild boar can contribute to the population seeing the species as unwanted, dangerous and/or as a pest: in Portugal, in the Montesinho Natural Park, 75% of the respondents said that "the wild boar should be exterminated", mainly because it "destroys crops". Furthermore, they do not recognise the ecological usefulness of this species, saying it is only useful because "it can be eaten or hunted" – in fact, the wild boar is the most hated animal in the region, even surpassing the wolf (Galhano-Alves, 2004). Thus, in order to better understand how wild boars impact the species with which they come into contact and how this conflict unfolds, it will be explained below how and why the presence of the wild boar can be harmful to human and animal health, agriculture, biodiversity, physical structures and overall safety.

i) Human and animal health

Wild boars are capable of carrying and spreading various parasites and diseases which have the ability to infect not only livestock and wildlife, but also humans (Jansen et al., 2007; Rossi et al., 2011). In fact, in the last 30 years and with the increase in the abundance of wild boar in Europe, the number of diseases harboured by them has grown

significantly (Boadella et al., 2012). Humans can be infected by many of these diseases, including brucellosis, salmonellosis and leptospirosis; as for wildlife and livestock, swine brucellosis, bovine tuberculosis and pseudorabies are some of the diseases of most concern to them (Davidson, 2006; Davidson & Nettles, 1997; Williams & Barker, 2001). However, and turning this issue into something even more problematic, the type of strategies used to combat this type of diseases in the livestock industry are not possible to use in wild boars, which transforms the species in a reservoir of diseases, making it very hard to eliminate this type of diseases in areas where the wild boar is present, threatening all who may come in contact with it (Hone et al. 1992, Hutton et al. 2006, Wyckoff et al. 2009).

ii) Garbage raiding

As the population numbers of wild boar increase, they have progressively ventured into urban and suburban environments, leading to a rise in the number of wild boars seen in these environments (Cahill et al., 2012). In fact, it is estimated that in the urban area of Berlin, for example, between 5000 and 8000 boars are present (ELO, 2012). These animals venture out into the cities in search of food and thus search in litter bins for leftovers, eventually destroying litter bags and leaving the entire surrounding area dirty and chaotic (Tack, 2018).

iii) Damage to agriculture

In Europe, wild boar is one of the biggest causes of damage to agricultural crops (Figure 1) (Schley & Roper, 2003). This is due to two reasons: consumption of crops or destruction of crops by rooting, digging and trampling them (Seward et al. 2004). As we saw above, the wild boar is an opportunistic animal that repeatedly feeds on crops, with Schley & Roper (2003) showing that agricultural crops represent an essential component in the diet of these animals in Western Europe, with them feeding on maize, potatoes, beans, peas and cereals. However, to feed, this species roots in soils, with all wild boars, regardless of gender or age, doing it on a regular basis (Mayer & Brisbin, 2009). This rooting breaks up and loosens the soil, and it can range from a simple leaf litter shallow displacement to large excavations, with the soil totally turned upside down and exposed to the sun (Arrington et al., 1999). This behaviour has several consequences: modification of the soil chemistry and nutrient cycle, reduction of plant cover and leaf litter, alteration of the decomposition cycle and impacting of the soil microbiota (Singer et al. 1984; Tisdell,

1982). Thus, once again, with the population numbers of this species increasing, it is not surprising that the damage to agriculture caused by wild boar has also increased dramatically in recent decades (Amici et al., 2012), whether caused by direct consumption of agriculture or through the destruction of it with the behaviours mentioned above. In Portugal, the crop that suffers the most from the presence of wild boar is maize (*Zea mays*), with the greatest number of damages recorded between June and August (Torres et. al, 2012). Finally, it is also important to note that often, when rooting the soil, wild boars also cause the destruction of infrastructures such as sprinklers, irrigation system pipes and floodgates (Tisdell, 1982), which they break to try to access the water contained in them; moreover, they are still able to create holes or even cross fences, which can lead to livestock fleeing or predators having easy access to it (Mapston, 2004), or cause damage to roads or dykes (West et al., 2009). In addition, rooting also leads to the creation of holes in the ground which, if not detected, can damage farming equipment and lead to accidents (Nunley, 1999). All these types of behaviour cause significant damage and contribute to an increasingly negative opinion about wild boar and to its undesirable presence.

Figure 1: Grass fields destroyed by wild boar in the study area in question. Source: Vitória Fontora

In Portugal, and although there is no complete and sequential record, the position of the Hunting and Aquaculture Resources Division of the Institute for Nature Conservation and Forests (ICNF) of Portugal is that this type of damage is increasing. In addition to this, they also mention that since 2017 these have been very elevated in the center of the country, driven by the fires that devastated the region and led to animals having to resort

to agricultural crops to have food. Finally, they also mention that Alentejo is also a region that is quite affected (ICNF's Cinegetic and Aquaculture Resources Division, personal communication).

iv) Damage to biodiversity

Here too, the fact that the wild boar is so well established and with such high population numbers brings some problems: invasive and/or very abundant species are serial threats to biodiversity, the ecosystem and its functioning, negatively impacting the region where they are present (Koons, 2014). These can affect plants, animals and/or habitats, and every year efforts are made, and a large amount of money is spent trying to control these species (Tack, 2018). The wild boar is therefore one of these very abundant (and in some cases invasive) species that damages biodiversity and ecosystems in many different ways - let us see:

a. Animals: wild boars can affect native wildlife in many ways: spread of diseases and parasites (as we have seen above), competition for resources, and direct predation (Sweeney et al., 2003). In fact, wild boars often prey on eggs and hatchlings of various birds, reptiles or amphibians (West et al., 2009), which in Florida, for example, has led to the decline of 4 amphibian species considered rare, threatened or endangered (United States Department of Agriculture, 2002). In addition, and also in Florida, they have led to the destruction of 80% of the nests (by excavating and feeding on the eggs) of endangered sea turtle species (e.g. *Caretta caretta* or *Chelonia mydas*), jeopardising the successful nesting and breeding of these species (Lewis et al., 1996; USDA, 2002). Finally, it is also important to note that predation of domestic cattle (like lambs (*Ovis aries*), goats (*Capra hircus*) or cattle (*Bos taurus*)) and/or game species also occurs, with a higher incidence in new-borns or immature animals (Seward et al. 2004): in Australia, wild boars prey on up to 32% of new-born lambs, with the predation rate increasing as the density of boars also increases (Plant et al., 1978; Choquenot et al., 1997).
b. Plants: rooting, digging and trampling can cause damage to plant regeneration, influence plant community structure, soil properties and nutrient cycling, and have consequences in the infiltration of water into the soil - the major cause of plant community disturbance is the rooting made by wild boars (Hone, 2002; Seward et al. 2004; Singer et al., 1984). Following this line of thought, wild boars contribute,

for example, to the easier spread of invasive plants as they thrive in highly disturbed areas, colonizing them faster than most native plants (Coblentz & Baber, 1987; Oldfield & Evans, 2016; Tierney et al., 2006) - in Florida, wild boars contributed to the decline of 22 species of plants considered rare, threatened or endangered (USDA, 2002). In addition, even in the cases where wild boar populations are reduced or eliminated, the recovery of communities is, in some cases, possible, but their composition may be permanently altered, leading to damage that is difficult to repair (West et al., 2009).

c. Habitats: at land level, wild boar can drastically affect forest restoration, with rooting being extremely harmful to the forests where this species is present. Thus, this behaviour can lead to displacing and damaging small seedlings, reducing oak regeneration (Sweitzer & VanVuren, 2002), accelerating leaf litter decomposition, which results in loss of soil nutrients and increased difficulty for seedlings to grow and survive (Singer et al., 1984). In addition, wild boars still cause direct damage through consumption of hardwoods and pines (Mayer et al., 2000; Campbell & Long, 2009). All this contributes to the increasingly difficult and tenuous restoration of forests (Landers et al., 1995). Aquatic habitats and wetlands are also very much affected by the presence of wild boars, especially as these animals prefer this type of habitat (Sweeney et al. 2003). Also in this case, rooting has consequences and, together with wallowing, it can lead to the production of algae blooms, destruction of aquatic vegetation, creation of bank erosion, muddying waters and reduction of fish reproduction and the use of the water by wildlife (mainly impacting insects and mussels) (Kaller & Kelso, 2006), contaminating the waters and affecting riparian habitats (Stevens 1996).

v) Road accidents

Although there is no concrete data on the number of accidents, at European level, involving wild boar, there are some authors that consider them to be the second most important factor contributing to the mortality of this species, surpassed only by hunting (Keuling et al., 2013; Toïgo et al., 2008; Sprem et al., 2013; Morelle et al., 2013). In fact, Häggmark et al. (2014) shows that in Sweden, between 2003 and 2012, the number of accidents involving wild boar increased significantly (from 752 to 4153), forecasting that the total cost of these accidents will increase from around 6 million EUR (in 2011) to a maximum of 33 million EUR in 2021. Similarly, in the Netherlands the number of accidents

involving wild boars rose from 142 in 1995 to 320 in 2003; in Switzerland, over the same period, the rise was from 212 to 412 (Van Vieren & Groot-Bruinderink, 2010). Lastly, in Germany in 2005, out of a total of 227,000 accidents, 13,700 (about 17%) involved wild boars (Carnevali et al., 2009). These accidents occur mostly with intermediate traffic levels (when boars feel more "comfortable" crossing the road) (Thurfjell et al., 2015) and in 69% of the cases they occur between 18:00 and 23:00, which coincides with their activity hours (Lagos et al., 2012). In addition, wild boar-related accidents peak between October and January, coinciding with the hunting season and the months with the longest nights (Lagos et al., 2012). One person is injured per 100 accidents with wild boar (Jägerbrand & Gren, 2018).

vi) Attacks on Humans

Although they are a rare event, wild boar attacks on people happen and can be dangerous. These attacks are not new, having been reported since prehistoric times and although in some rare cases they occur without any apparent provocation, in the vast majority of cases these attacks occur when the boars feel threatened, are hurt or trapped (Goulding, 2003; Mayer, 2013; Mayer & Brisbin, 2009). Most attacks occur in winter and during the day and are also more common in rural areas. In addition, 82% of attacks involve solitary males (Mayer, 2013). As mentioned above, the consequences can be serious, ranging from punctures and lacerations, contusions, bites (which can lead to infections), broken bones or even death: every year, an average of 3.8 people are fatally injured by wild boars globally (Barss & Ennis, 1988; Hatake et al., 1995; Mayer, 2013). Thus, and although rare, it is important to avoid engaging in risky behaviours, such as walking alone in areas of dense bush and understory vegetation, chasing a boar or trying to feed or touch these animals (Mayer, 2013).

Despite all this, it is important to realize that the wild boar also has an important ecological role with varied benefits not only for the ecosystem, but also for humans, and has even been considered an ecosystem engineer (Sandom et al., 2012): species that are responsible for creating, modifying, maintaining and/or destroying habitats and that, as a result, have major impacts on ecosystem functioning (Byers et al., 2006; Jones et al., 1994). These ecosystem engineers are highly important and are often used to assist in the restoration of ecological processes and habitat management (Sandom et al., 2012). Thus, for example, grazing and physical disturbance caused by wild boar are critical

processes in plant community dynamics (White & Jentsch 2004; Gordon & Prins 2008), and rooting can contribute to the creation of germination niches (Sandom, 2010), providing opportunities for pioneer species to re-establish themselves (Sandom et al., 2012). Rooting can also be a substitute for natural physical disturbances such as forest fires, which will contribute to the creation of new habitats for endemic species (Kotanen, 1995). In addition, early-successional plants are usually found on rooted sites and these species are extremely important as they will serve as food for endemic wildlife (Everitt & Alaniz, 1980). It is also important to note that wild boar is a key species in trophic chains, being prey to a variety of animals (lynxes, bears and wolves (Heptner et al., 1988)) and has also been reported to be involved in symbiotic relationships with scrub jay (*Aphelocoma coerulescens*) and common crow (*Corvus brachyrhynchos*), where the birds feed on the ectoparasites found on the wild boar (Barber & Morris, 1980; Kilham, 1982). So, while the negative aspects of wild boar are reported most often, it is also important to remember that despite these, wild boar play an important, and in many cases crucial, role in their habitat.

3. Solutions and Management Techniques

Due to all the reasons above, it is undeniable that the wild boar ends up being seen as a problematic species. In fact, this species was even included in the IUCN list of 100 "World's Worst Invaders" (Lowe et al., 2004). Furthermore, even in cases where the species is native or seen as essential, it can also be seen as problematic if it is too abundant (Tack, 2018). This is how wildlife management emerges, the objective of which is to ensure that the population has the capacity to regenerate adequately, while keeping the numbers at a level that minimizes the damage caused by the species (Tack, 2018). In this line of thought, there are a number of solutions that can be applied to reduce the impact of wild boar on human and animal health, agriculture, biodiversity and physical structures. These solutions can be lethal (hunting, trapping or poison) or non-lethal (fencing, supplemental feeding, vaccination or contraception) (West et al., 2009).

i) Hunting

Hunting is one of the most effective methods of controlling wild boar populations (Beskardes et al., 2010): it not only has the capacity to reduce population density, but also

contributes to reducing the damage caused by it (Geisser & Reyer, 2004; Sweitzer et al., 2000). However, these hunting programs must consider a myriad of important factors: due to high adaptability, high reproduction rates, the application of sustainable hunting strategies and legal restrictions on wild boar hunting, the resulting hunting rates are insufficient: recreational hunting is not consistent and intense enough to reduce and/or regulate wild boar populations (Keuling et al., 2013; Massei et al., 2014; Massei et al., 2011). To this end, it is crucial that hunters' interests are aligned with local management objectives, and that hunting is applied in conjunction with other methods (Keuling et al., 2016; Massei et al., 2014; Massei et al., 2011). In addition, it is also important to consider that high hunting pressure, food availability and biased sex and age ratios lead to higher reproduction rates (Gethöffer et al., 2007; Servanty et al., 2011; Servanty et al., 2009). Thus, in order to be effective, hunting programmes must be consistent and intense (West et. al, 2009) and battues seem to be the most effective method for population control (Geisser & Reyer, 2004). In Portugal, wild boar hunting can be carried out using various methods, such as stand, stalking, battues, hunting parties and by spear. In orderly hunting grounds, this is allowed throughout the year (with some exceptions), while in non-orderly hunting grounds, hunting can only take place between October and February, by battues and hunting parties in pre-defined locations (Decreto-Lei n.º 202/2004 of 18 August of the Ministério da Agricultura, Desenvolvimento Rural e Pescas, 2004). The ICNF also encourages and enables actions to control wild boar population: in the low hunting season, a public notice is issued to invite hunters who are available to carry out this type of action (ICNF, 2020). In addition to this, the ICNF also carries out population correction measures in cases where there are complaints of crop destruction by farmers. In Portugal, these are the only measures used to try to alleviate the conflict between wild boar and man (ICNF's Cinegetic and Aquaculture Resources Division, personal communication). Finally, it is also important to note that hunting can also be carried out with the help of trained dogs, which locate and capture wild boars (dogging) (Mayer & Brisbin, 2009) - this type of hunting has been successfully used in several population reduction programmes (Choquenot et al., 1996; Dickson et al. 2001).

ii) Trapping

The use of traps is one of the most popular methods for reducing the population of this species, as traps are relatively simple and cheap to implement, and boars are relatively easy to trap (Mayer & Brisbin, 2009). In fact, Choquenot et al. (1993) found a population

reduction of up to 90% with intensive use of traps. There is a wide variety of trap models and they can be divided into portable or fixed traps (Mayer & Brisbin, 2009) - however, most are made up of a closed area to which one has access through a gate or one-way entrance (Land Protection, 2001). Thus, wild boars are lured into the traps with the use of a bait (food) and are subsequently euthanized (West et al., 2009). The success of these varies mostly with the availability of food sources for the species, so it is advisable to use them in the dry season and/or in conjunction with other removal methods (Barrett & Birmingham, 1994; Mayer & Brisbin, 2009). Finally, the use of snares is also quite common, especially in conditions where it is impossible to set traps or where boars are suspicious of traps. Snares are basically loops of steel cables that close around, for example, the neck or a leg and do not open again. They are therefore cheaper and more practical alternatives to traps (West et. al, 2009). In fact, it has been shown that snares can even be more successful than shooting or dogging (the use of trained dogs to hunt wild pigs) (Muir & McEwen, 2007).

iii) Toxicants

The use of toxins or poisons has been discussed as a lethal method to combat boar (Lapidge et al., 2009). In fact, if applied well, this type of method can lead to large population decreases of the species (Poché et al., 2018; Snow et al., 2020). In addition, Coblentz & Baber (1987) showed that it can still be eight to eleven times cheaper than using traps or hunting, respectively. However, to the extent that it has been possible to ascertain, no type of toxin has so far been approved for use either in Europe or the USA. This is because the compounds tested are unsafe to other animals or the environment, may bioaccumulate and/or lead to a painful death (Mayer & Brisbin, 2009; Snow et al., 2020). Thus, there has been a general effort by the scientific community to identify a toxicant capable of causing a non-painful death with no side effects on other animals or the environment (West et al., 2009). In Australia, by contrast, this technique has been widely used to control wild boar populations (Choquenot et al. 1996). In addition, it is advisable to combine it with other lethal techniques to allow the elimination of some residual animals (Giles, 1973).

iv) Fencing

The use of fences around areas of high value or importance can be an optimal non-lethal strategy to mitigate the damage caused by wild boar (Mayer & Brisbin, 2009). This

type of fencing can be wire, electric, or a combination of the two (West et. al, 2009): Reidy et al. (2008) reported a reduction in the number of daily intrusions of up to 50% with the use of portable electric fencing. Furthermore, it is important that these are "wild boar-proof": this ungulate can jump up to 1.5 metres in height and so it is important that the fences prevent boars from passing either over, through, under or around them, and must be high enough, well buried and made of strong materials (Mayer & Brisbin, 2009; Tack, 2018). Thus, the use of robust wire fencing with the addition of electrified wires seems to be the best version to resist wild boars and is also effective in restricting animal movement (Hone and Atkinson 1983). However, the cost of implementing such measures and consequent maintenance (caused not only by wild boar intrusion attempts, but also by natural incidents) is quite high, so some authors advise it to be used only in small areas (Mayer & Brisbin, 2009; Tack, 2018).

v) Supplemental feeding

Supplementary feeding has been used not only to reduce the level of damage caused by wild boar to crops and structures, but also to increase the success of hunting programmes (Tack, 2018; Wilson, 2005). This method of mitigation is based on the premise that wild boars tend to seek new sources of food during winter and spring (when the available food is low), which in turn leads to increased damage to agriculture (Tack, 2018). Thus, providing supplementary food during food shortage periods may lead to reduced damage (Brandt et al., 2006). In this way, supplementary feeding can be presented in feeding stations or in planted lots. In addition, it can contain both natural foods (grass for example) and agricultural crops (maize for example) (Mayer & Brisbin, 2009). That said, some authors have reported that this type of method has not caused a significant decrease in the level of damage (Geisser & Reyer, 2004) - this can be avoided with planning and coordination: feeding should be placed in natural areas far from agricultural fields, for example (Goulding et al. 1998). In fact, Vassant (1994) reported a decrease of up to 70% in wheat fields when maize was provided as supplementary feed.

vi) Vaccination

Vaccination is a non-lethal method that seeks to control the spread of infectious diseases in order to protect wild animals, domestic livestock and, consequently, humans (West et al., 2009). The World Organisation for Animal Health (WOAH) (2021a) tells us that classical swine fever is, as mentioned above, a viral disease that affects both wild and

domestic pigs through their contact with the former, which consequently leads to the slaughter of all infected animals. In 1997, an outbreak of classical swine fever in the Netherlands led to the destruction of 11 million pigs at a cost of about $2.3 billion (WOAH, 2021a). Since then, the scientific community has focused on testing different methodologies for the development of a vaccine. Thus, at present, there are several vaccines that effectively control the disease (van Oirschot, 2003; Blome et al., 2006). In the case of African swine fever, also a viral disease which again affects both wild and domestic pigs, there is still no vaccination available, despite high economic and production losses (WOAH, 2021b). However, once again, the scientific community has been carrying out several studies in order to find an effective vaccine to protect both wild and domestic pigs (Barasona et al., 2019; Teklue et al., 2019).

vii) Contraception

Contraception has emerged as a possible non-lethal alternative method to cases where the application of lethal methods is viewed negatively by the public (Massei et al., 2012). Thus, the scientific community has focused on developing contraceptive vaccines that can be used in boars and some studies show promising results in the application of intramuscular injections of the gonadotropin releasing hormone (GnRH) (Massei et al., 2008; Massei et al., 2012; Quy et al., 2014). This injection induces infertility in both males and females, having a long-term effect and without risks or side effects on animal health (Campbell et al., 2010; Killian et al., 2006; Massei et al., 2012). However, as mentioned above, this option needs to be administered intramuscularly, an unrealistic method for field application (Oliviero et al., 2019). Thus, the next step on which scientists are focused is to develop an oral form of the vaccine so that it is easier, more practical and faster to administer.

Considering the above, it is important to bear in mind that there is no perfect and single method: since the problem is complex, the solutions must also be complex. Thus, some authors have suggested and used integrated management approaches (Monaco et al., 2010; Massei et al., 2011): combining and using different prevention and reduction methods at the same time in order to optimize results (United States Department of Agriculture, 2002). Thus, for example, in the case of wild boar, there has been a combination of non-lethal and preventive methods with lethal methods and also the use of compensation for the damage caused by the species (Monaco et al., 2010).

4. The Importance of the Human Dimension in Human-Wild Boar Conflict

In recent years, the number of studies focused on studying and understanding the conflict between humans and wildlife has increased (Dickman, 2010). This, in turn, shows that the conflict between Man and wildlife remains a relevant and current topic that also continues to increase (Skogen et al, 2008; Woodroffe et al., 2005). In addition, studies show that the public identifies wildlife damage as the major cause of human-wildlife conflict (Sillero-Zubiri & Laurenson, 2001). Thus, one would expect that, by carrying out a management strategy and then putting into practice some of the solutions spoken above, thereby reducing the damage, the hostility towards the species causing the conflict would disappear. However, this rarely happens: it is reported by several authors that long-term conflict resolution is rare, even where appropriate strategies are applied (Marker, 2002; Webber et al., 2007). An example of this was demonstrated by Marker (2002): several measures have been implemented in Namibia to reduce the persecution of cheetahs. However, although the measures were successful, 40% of farmers still removed the feline from their land, even if it did not cause them any problems. Thus, it must be considered that the causes of conflict are usually complex and ingrained, going beyond the damage caused by the species and may be influenced, for example, by the perception of the risk that the species represents to the population, by the occurrence of disproportionate responses and/or by social influences (Dickman, 2010). In fact, where managers have not considered the different and sometimes contrasting social, cultural, economic, emotional, mental and spiritual values of different audiences (Decker et al, 2012; Woodroffe et al. 2005), the implementation of strategies has only contributed to further increasing the conflict between the public and wildlife (Bronner, 2008; Dandy et al., 2011; Green et al. 1997). As an example, the role of certain animals in popular wisdom and the resulting perceptions that certain species are evil and dangerous (as is the case, for example, with wolves) should be mentioned, which again means that even if the species ceases to cause conflict, fear, antagonism and hostility will probably continue to lead to the persecution of the animal (Dickman, 2010; Linnell et al., 2003). In fact, the most difficult task when managing and conserving wildlife in cases of conflict with humans is often managing the different people and stakeholders involved in the same. Thus, the use of attitudinal studies has been increasing in this type of issues, since they are crucial to understanding what the opinions, complaints, and suggestions regarding the conflict (and

consequent conservation) of the affected public are (Li et al., 2010). It is therefore crucial that wildlife managers are available not only to listen to the public, but also to integrate their complaints and suggestions into their management plans, considering the dynamics of the population itself (Frank et al., 2015): successful wildlife management implies a trust-based dynamic between the rural population and government agencies (Davies & White, 2012; Yasmi et al. 2006). This can be achieved by using different approaches: interviews, focus groups and public meetings can help understand the feelings, opinions, and attitudes, defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993), of those involved. This in turn will help to create interdisciplinary and integrated plans that consider the socio-economic, cultural, and ecological context and serve the purposes of both wildlife managers and the public (Dickman, 2010; Frank et al., 2015).

In line with this, it is equally important to understand how well informed the population is about the species one is trying to conserve: the truth is that less educated audiences are associated with more negative opinions and, consequently, attitudes, often positioning themselves against its conservation (Bjerke & Østdahl, 2004; Kellert & Berry, 1980; Schlegel & Rupf, 2010). Thus, it becomes crucial to collect and analyze existing knowledge about the species to be conserved, so that we can locate information gaps and false and biased information in order to combat it. This, in turn, will allow the population to become more educated and, consequently, less hostile towards the species and its conservation. This is where Local Ecological Knowledge comes in. Local ecological knowledge, or LEK, refers to lay and/or experiential knowledge about the environment surrounding a certain individual, obtained on the basis of observations, practical contact with nature and acquired scientific knowledge, and which is passed on over several generations (Berkes et al., 2000; Yli-Pelkonen & Kohl, 2005). This term is an integral and central part of ethnobiology: a multidisciplinary discipline that focuses on studying "the dynamic relationships between people, biota and the environment" (Ethnobiology Working Group, 2002). LEK is therefore an essential tool for the creation of management plans and conservation programs that are sensitive to the cultural and social contexts surrounding the species in question (Drew, 2005). In addition to this, it can also be an ally of scientific knowledge, as it can help to complement, with local knowledge, information that is rare or non-existent (Le Fur et al., 2011; Uprety et al., 2012). Thus, being a growing area, articles focused on LEK and that contribute not only to conservation, but also to the addition of ecological information on species, have increased (Baird & Flaherty, 2005; Braga & Schiavetti, 2013; Phuanukoonnon et al., 2006; Silvano & Begossi, 2005). In Portugal, the

scenario is repeated, with an increase in the number of studies developed in this area (Álvares et al., 2011; Braga et al., 2017; Carvalho & Frazão-Moreira, 2011; Ceríaco, 2012; Lopes-Fernandes et al., 2018) - however, as far as we could ascertain, with the exception of Galhano-Alves (2004), no study involving LEK and the wild boar was found.

With all the above in mind and considering the absence of concrete and effective management plans for the wild boar in Portugal, it is of utmost importance to carry out a study focused on the human dimension of wild boar conservation. Thus, using semi-structured interviews, the aim of this work is to collect 1) the LEK and 2) the feelings and attitudes of the public affected by the damage caused by the wild boar, so that they can be considered in future management plans, contributing to make them more realistic and successful.

Methods

1. Study Area

This study was conducted in a village in the county of Oliveira de Frades, district of Viseu, Portugal (Figure 2). It is part of the Beira Alta region and it has a population of about 1,011 inhabitants and an area of 15.17 km^2 (Instituto Nacional de Estatística - INE, 2012). The interviews were carried out all over the village, trying to collect opinions both from land owners close to the Vouga river and from farmers living in a more mountainous and isolated environment (Figure 2). The population is closely linked to agriculture, and it is extremely common for inhabitants to have, at least, a small plot of land. However, most of them have several plots of land where they plant potatoes, beans, maize, tomatoes, among others.

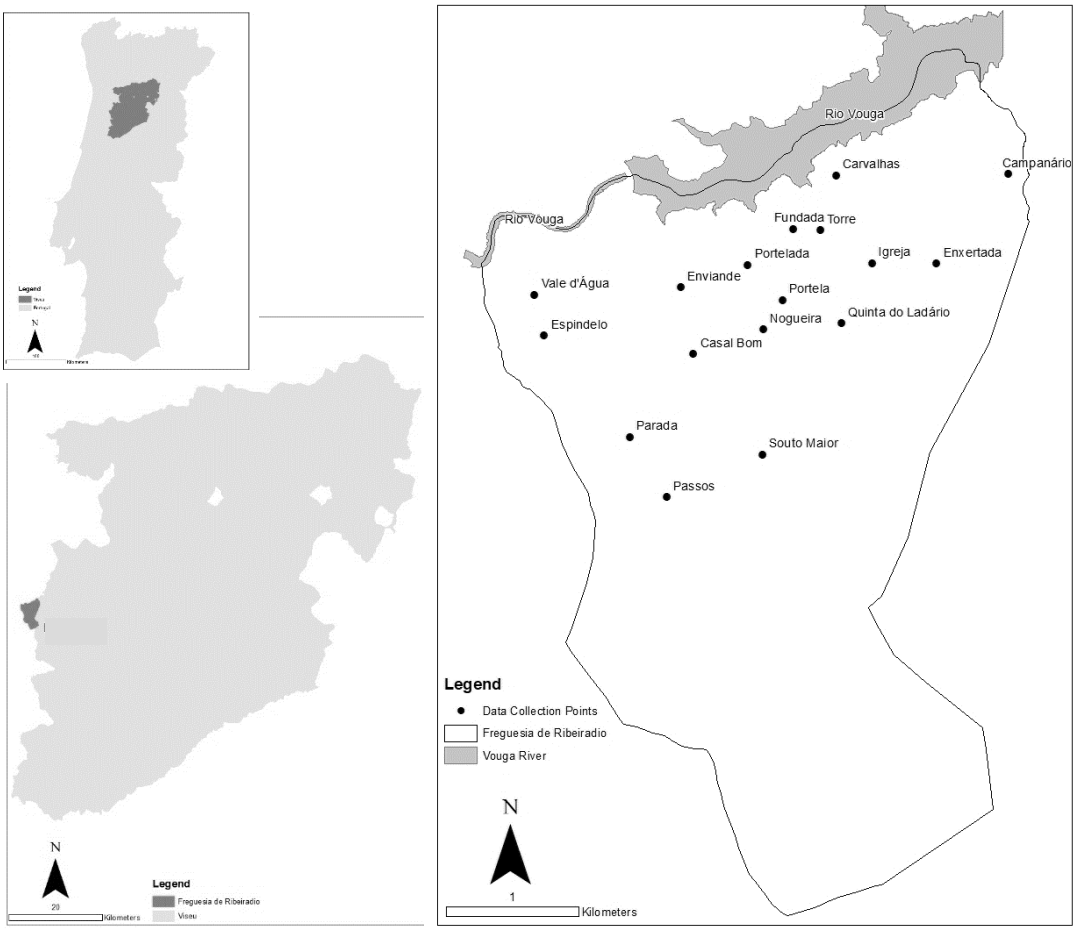

Figure 2: Map of the study area, showing its location in Portugal and in the district of Viseu and the respective points where the study data was collected. Credit: Conceição, J.

2. Interview Data Collection

In order to collect the LEK and the feelings and attitudes of affected farmers, 41 semi-structured interviews were conducted. This number of interviews (> 40) is the advised number so that the results faithfully translate the vision that local communities have of biological resources (Bernard, 2013). Interviewees fell into one of two categories: primary farmers (those who live exclusively from agriculture) or secondary farmers (those who use agriculture for self-production or as a hobby). The interviews were carried out face to face in the researcher's village of residence, which facilitated the creation of an environment of trust between researcher and farmer, as interviewees recognized the researcher as an integrated part of the village. Thus, this environment of trust allowed honest and unbiased conversations to develop. The interviews took place on a one-to-one basis at the farmers' homes and were carried out during March and April of 2021. In order to find farmers affected by wild boar, the snowball method was used whenever possible (Bailey, 2008), in which farmers were asked if they knew other colleagues who also suffered from wild boar attacks on crops and, after interviewing the farmers mentioned by the former, the latter indicated new farmers and so on. A test interview was conducted before starting the interviews in order to build a clear and complete script (Huntington, 2000; White et al., 2005).

Before starting the interview, the researcher explained the objectives of the work and obtained the consent of the farmers not only to use their responses, but also to record the interview using an electronic device. The Statement of Informed Consent (Additional File 1) was signed by both parties and given to the farmer. Thus, the interview began with a projective test (Costa-Neto et al., 2009): a colorful and elucidative image of the species in question (*S. scrofa*) was shown on an electronic device and, subsequently, the farmer was asked to indicate which animal was shown in the image. In this way, only individuals who recognized the ungulate were interviewed. The interview was divided into three parts: a first part consisting of collecting socio-demographic parameters of the farmers (age, education level, etc.), followed by a second part assessing the ecological knowledge regarding wild boar (feeding, habitat, predators, etc.); lastly, the third part focused on attitudes towards the conflict, the damage caused by it and the consequent need for ungulate conservation (more details in Additional File 2).

3. Data Analyses

The species mentioned by the interviewees were analyzed according to the IUCN Red List of Threatened Species (https://www.iucnredlist.org/), the Global Biodiversity Information Facility (https://www.gbif.org/) and íNaturalist (https://www.inaturalist.org/). A quali-quantitative analysis was carried out from the data resulting from the interviews, where it was verified and compared with scientific literature, following an emic-ethic approach (Harris, 1976; Newing, 2010). The results were organized and standardized in Microsoft Excel (2016).

Results

1. Socio-Demographic Variables

The interviews took place at various locations in the study area. 54% of the interviewees were male and 46% were female, and the average age was 62.54. Following the Portuguese educational classification, 22 (54%) of the respondents had attended school up to the first cycle, 4 to the second cycle, 7 to the third cycle and 8 to secondary school. There were no illiterate individuals or individuals with higher education in the sample. Only 22% (N=9) are primary farmers, with the remaining 32 presenting other forms of income, using agriculture only for self-production or as a hobby (secondary farmer). Within the secondary farmers, 47% (N=15) were retired. All but one of the respondents have always had a connection to agriculture and had been involved in family farming since childhood. Although only 22% said they were primary farmers, 59% said they dedicate themselves to agriculture throughout the day, as all the retired and the unemployed ended up being fully dedicated to the agricultural land since they were at home without occupation. Furthermore, 3 of the interviewees dedicated half a day to agriculture, 11 could only dedicate themselves to it after working hours and during weekends and 3 only dedicated themselves to it during the weekend.

2. Local Ecological Knowledge

i) Wild Boar Folk Taxonomy and Sighting Frequency

All interviewees recognized the ungulate in the image they were shown, identifying it as "javali". In addition, two of the respondents also mentioned the use of the name "navalheiro" in the case of older males. None of the farmers referred to the scientific name. In addition, only one respondent had never seen the ungulate in person, with two others reporting having seen it only once - in contrast, 93% (N=38) of the farmers had seen wild boar more than once.

ii) Habitat, Behavior and Diet

When asked about the preferred habitat of the ungulate, 68% (N=28) indicated wooded areas, as many of the farmers' farmlands are surrounded by them. Three of the respondents mentioned brambles (*Rubus ulmifolius*), saying that wild boars used to hide

among brambles of adjacent lands that were left abandoned; two of the respondents said that wild boars were mostly found near streams, as they like to bathe in water and, consequently, agricultural lands near streams suffered more damage; 8 of the farmers said they did not know the habitat of ungulates.

Regarding behavior, over half the farmers (56%, N=23) stated that wild boar prefer to walk in groups (3 or more animals), with 12 farmers saying they can both walk alone and in groups, and 3 saying they are solitary animals. A further 3 respondents said they did not know the animal's preference on this question. In addition to this, 63% (N=26) of respondents mentioned that the ungulate was a nocturnal animal, some of whom mentioned that the ungulate was more active at dusk and dawn. One respondent said that the wild boar was diurnal, and 14 (34%) others mentioned that it was active both day and night, the crucial factor for approaching farmlands being the absence of humans.

Finally, regarding food, opinions were many and varied. The most mentioned was chestnut (fruit of *Castanea sativa*), mentioned by 35 farmers (85%), followed by maize (*Zea mays*), mentioned by 32 farmers (78%), and acorn (fruit of trees of the *Quercus* genus), mentioned by 21 farmers (51%). The remaining elements of the diet vary and are presented in Table 1. Several farmers also mention that the wild boar, like the domestic pig, "eats whatever it finds".

Table 1: Diet of wild boar according to the farmers interviewed, and respective scientific names, with the number of farmers who mentioned certain food item (N) and consequent percentage (%).

Wild Boar Diet	**N**	**%**
Chestnut (*Castanea sativa*)	35	85
Maize (*Zea mays*)	32	78
Acorn (*Quercus* genus)	21	51
Roots	11	27
Common Asphodel (*Asphodelus ramosus*)	5	12
Italian arum (*Arum italicum*)	4	10
Walnuts (*Juglans regia*)	3	7
Fruit	3	7
Grass	2	5
Insects	1	2
African wood-sorrel (*Oxalis pes-caprae*)	1	2
Root Beet (*Beta vulgaris* var. *vulgaris*)	1	2

iii) Predators, Hunting and Conservation

When asked about the occurrence of predators, 27 (66%) of the respondents say they are not aware that wild boar have predators, with the remaining 14 (34%) not knowing the answer. This was the question generating the most doubts and with the most farmers not knowing the answer. Similarly, when asked if hunting was allowed, there was also a large amount of doubt and a large number of farmers admitting to not knowing the answer (N=12; 29%). Of the remainder, 5 answered that hunting was not allowed, 18 said it was only allowed in the annual raids conducted by hunting associations and 6 said it was as long as the hunter had a license and permit.

Finally, it was also asked what the conservation status of wild boar in Portugal was, i.e., whether there were many specimens or whether the number of specimens was decreasing. The overwhelming majority (N=38; 93%) had no hesitation in answering that there were many and in excess. The remaining 3 respondents answered that there were an intermediate number of animals, believing that there had been more.

3. Farmers' Attitudes and Feelings

i) Frequency and Increase in Attacks on Farmers' Crops

The first questions was about the frequency of the attacks carried out by the wild boar on the farmers' lands. All the respondents answered that it was an occurrence that happened every year, more than once a year. In fact, 34 (83%) of the respondents answered that the wild boar caused property damage at various times of the year, more than once, with only 17% saying that it caused property damage only in the maize season (although this occurs more than once a year). Thus, when asked whether the frequency of attacks on farmland had increased in recent years, 35 (85%) of the respondents agreed with the statement, 12% (5) said they had not noticed any increase and one respondent said they did not know. When the 35 farmers were asked about the possible reason for this increase, the answers varied: almost half of them (N=17; 49%) blamed the recent construction of a dam, with one of two explanations: loss of habitat or the noise emission and consequent confusion of the construction. Of the remaining farmers, the reasons given were: 29% (N=10) blame the abandoned and wild farmlands, which foster hiding places for the animals; 17% (N=6) refer to the high reproductive capacity of the ungulate; 14% (N=5) blame the lack of regular and effective battues; 9% (N=3) blame the authorities

responsible for the introductions of this species (introductions and/or re-introductions of wild boar are legally prohibited in Portugal (ICNF's Cinegetic and Aquaculture Resources Division, personal communication)); 6% (N=2) say it is a consequence of the lack of food in the wild boar's natural habitat, which makes it have to look for food elsewhere; and finally, 3% (N=1) refer the forest fires that have ravaged the region in recent summers.

ii) Affected Crops and Monetary Losses

Of all the crops that farmers said were destroyed by wild boar, the one that was mentioned the most was undoubtedly maize (*Zea mays*), mentioned by 36 farmers (88%). In addition to maize, the wild boar also causes damage mostly to grass fields (N=22; 54%), potatoes (*Solanum tuberosum*) (N=20; 49%), and chestnuts/chestnut trees (*Castanea sativa*) (N=8; 20%). Besides these, it is important to note that 11 farmers (27%) complained that, in addition to the damage to agricultural crops, the wild boar also destroys and knocks down the stone fences that exist separating the various farmlands, further increasing the damage. The other crops that are affected and the frequency with which they were mentioned by farmers are shown in figure 3. Farmers also tell us that despite the variety of different crops destroyed, the wild boar only feeds on maize or chestnuts, and even in these cases, it only does so in small quantities. Many farmers also said, in relation to maize, that the boar "destroys more than what it eats" and that "if it only damaged what it eats, the problem would be minor. The problem is that it destroys a field of maize and only eats a very small portion". They further added that the wild boar only eats the maize when it is soft, "em leite"; as soon as it starts to harden, the ungulates stop feeding on the maize, causing only destruction. In relation to the chestnut trees, the wild

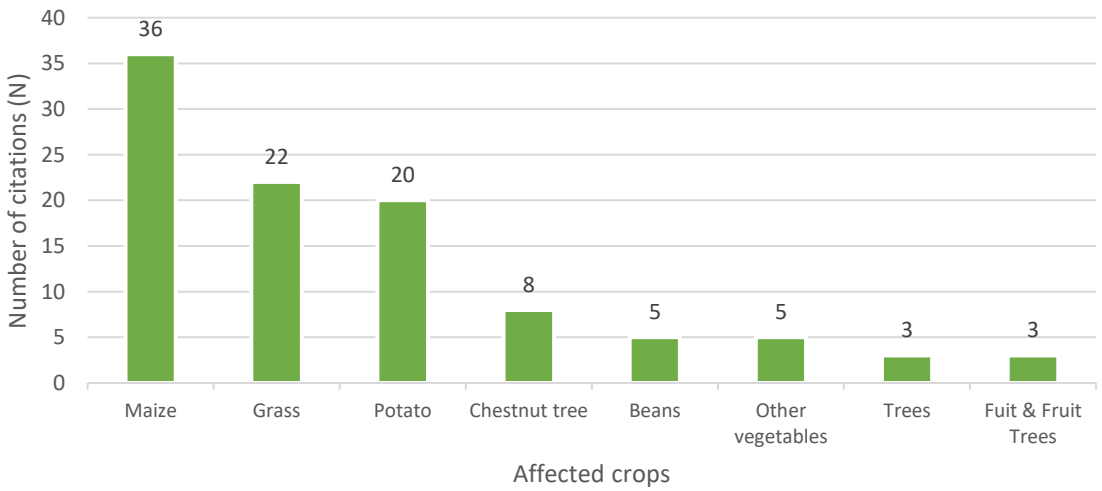

Figure 3: Crops affected by wild boar and the number of times they were mentioned by the farmers.

boar leaves the earth around the trees completely turned upside down as it searches for chestnuts.

Considering all the above, when asked which crops the wild boar caused the most damage to, 88% (N=36) of the farmers said that the greatest damage caused by the wild boar comes from the destruction of maize crops. Apart from these, 2 farmers said that the most damage comes from destruction of potatoes, 1 from damage to oak trees, 1 from damage to pine trees and 1 from destruction of stone fences. Thus, when asked if they had high monetary losses, 95% of farmers said yes, with only two saying no. In fact, several farmers reported losing entire maize fields because of the wild boar. In addition, it is also important to add that respondents pointed out that this maize, which is broken down and trampled by the ungulates, is not suitable for later use as animal food because the animals do not eat it - which farmers attribute to the fact that the maize contains the scent of wild boar. Finally, it should be added that a large portion of farmers said that, although the monetary losses are high, "what is most painful is the heartbreak of arriving and seeing our work of several months completely destroyed".

Finally, and in light of the high level of damage caused by wild boar, farmers were also questioned if they usually report or had ever reported such damage. The vast majority (N=36; 88%) say they do not report nor have ever reported, there being a great discredit in the process and in the authorities involved, with practically all of them saying "Why report it? It is no use!" or "Report to whom? Nobody helps us!". From the remaining 5 farmers who admit to having previously reported, 4 of them have only done so once and one has done so more than once. Respondents say they have tried to report to the local authorities or local hunting association, but in none of the cases there was any outcome or help for the farmers involved. Finally, it was also asked if farmers were aware that they could report this type of problems to ICNF in order to be carried out population corrective measures. Almost all of the respondents (N=40; 98%) said they did not know that this was possible, also demonstrating a certain incredibility that these corrective measures would even be carried out. The only respondent who was aware of the situation was a farmer who works together with ICNF.

iii) Damage Management Techniques and Solutions

When asked about the use of any measures or strategies to hinder or prevent the entry of wild boar, the answers were divided. A large proportion of farmers (N=18; 44%) say they have implemented the use of fencing in order to try and save their crops. Of

these, 72% (N=13) say they are effective, 22% (N=4) say their effectiveness is partial, and 6% (N=1) say they have not worked. In fact, farmers admit that fences only work "if they are firmly placed" and that "all it takes is one little hole poorly covered and the wild boar will find a way in". Furthermore, there were several reports of farmers who, despite having placed fences around their farmland, the wild boar ended up lifting them and entering the farmland anyway. Eleven (27%) farmers use other strategies (Figure 4) to try to scare away the wild boar: spotlights, rubbish bags, mothballs, radios, watchdogs, zinc cans and creoline in bottles are some of those mentioned. However, their effectiveness is extremely low, since, according to farmers, it only works as long as the animals do not get used to the novelty. Finally, 12 (29%) farmers say they do not use any measure against wild boars.

Figure 4: Example of a strategy adopted by a local farmer to protect his fruit trees from wild boar.

Having said this, they were asked what could be, in their opinion, the solution to this problem. A large majority (N=32; 78%) had no hesitation in answering that hunting was the solution. Many of those interviewed said that hunting should be more regular, with some further advocating that it should also be more unrestricted, to allow those affected to kill animals that cause them harm. It is also important to mention that there is also some discrediting of hunters and hunting associations, with many of the interviewees saying phrases such as "hunting is worthless, because they can't catch them". Adding to all this, the presence and use of snares is still quite current and common, although illegal. Thus, when respondents were asked whether or not they agreed with hunting, the overwhelming majority (N=39; 95%) said yes, with only two farmers opposing using hunting as a solution. In addition to hunting, 2 farmers (5%) suggested stopping introductions, 1 suggested compensation payments, 1 the creation of protected and closed areas for wild boar, and 1 the translocation of animals to other locations. Apart from these, 4 farmers said they did not know how to solve this problem.

Finally, a hypothetical scenario was presented to the respondents: in order to try to solve this question, would the farmer prefer that: a) hunting became more regular and

intense; b) a subsidy was paid to help fence the cultivated land or c) compensation was given for the damage caused by ungulates? Almost three-quarters of the respondents (N=30; 73%) replied that they preferred hunting, as this would "solve the problem at its root and be a solution that was good for everyone". Of the remainder, 8 (20%) said they would prefer to receive a fencing grant, with several saying that "any grant, however small, would be welcome", and the last 3 said they preferred compensation. In addition, there is again some disbelief that compensation will be paid, or even in the case it is paid, "it will never fully pay for all the work involved and the heartbreak of seeing our work destroyed".

iv) Conservation

Finally, some questions were asked regarding the conservation of wild boar. Firstly, they were asked what they would like to see happen to wild boar population numbers: increase, stay the same or decrease. Despite not being one of the options, over half of the farmers (N=21; 51%) did not hesitate to say that they would prefer the “population numbers to be eradicated” and the ungulate to disappear. The remaining 20 respondents said they wanted the wild boar numbers to decrease. So, in this line of thinking, it was further questioned whether we should conserve the wild boar, even if it continued to do damage to agricultural crops. Again, the vast majority (N=31; 76%) immediately answered no, with only 10 respondents saying yes - but only if the damage they do would decrease. When questioned if the wild boar brought any benefit, there was, once again, a great promptness in saying no by 90% of the respondents, saying that "it is not even good enough to eat". The remaining 4 respondents admit that the wild boar can bring some benefit, and although they do not know for sure which, they defend that "if the animal exists, it must serve some purpose".

Discussion

1. Socio-Demographic Variables

The results show that agricultural production is increasingly associated with an older age structure (average age of 62.54). This is in line with the 2009 Agricultural Census data, which showed that, in Portugal, the average age of farmers is 63 years old, and Beira Interior (BI), the region where the study area is inserted, presents an average farmer age of 66 years old (INE, 2009). In addition, this region had only 6% of farmers under 45 years old, which also shows how agriculture is an area that has little appeal and few incentives for the younger age groups. In addition, it is also important to note that 58% of the agricultural producers in BI are over 65 years old (INE, 2009).

As for the presence of women in the profession, the same Agricultural Census shows that agriculture is still occupied mostly by men: only 30% of farmers in BI are women (INE, 2009). Our results show a higher percentage of women (46%), but men are still the majority.

Regarding education, agricultural production continues to be a profession associated with low schooling: although there are no illiterates in the sample, more than half of the respondents have only studied up to the first cycle, which is in line with the Agricultural Census, that showed us that both in BI and at the national level 52% of farmers have only studied up to the 4th grade (INE, 2009). Thus, much of the knowledge that these farmers have comes from past generations, from their peers or from practical experience. However, this trend is being combated because, in the last decades, the number of illiterate farmers in Portugal has decreased by 53% (INE, 2009).

Lastly, when asked about their source of income, we found that only 22% are primary farmers. In fact, the Agricultural Census showed that, at national level, only 6% declared that they obtain their income exclusively from agriculture (INE, 2009). This absence of primary farmers can be justified by something that many of the respondents told us during the interviews: family farming is in extinction - due to the absence of incentives, the increase in losses (caused by wildlife or natural disasters), and the lack of new farmers in lower age groups, more and more farmers are giving up farming. In fact, the number of farmers and farms have been reduced (by 27% and 25%, respectively) in recent years. Furthermore, of the secondary farmers, 47% of the respondents are retired (64%

nationally), which again shows how the profession is aging and adds to the number of challenges family farming faces (INE, 2009).

Thus, and considering our results, the farmer-type is male, around 63 years old and has only studied up to the first cycle. He is a secondary farmer, and his main source of income is his pension.

2. Local Ecological Knowledge

i) Wild Boar Folk Taxonomy and Sighting Frequency

All respondents referred the name "javali" when they were shown a colorful and elucidative image of the species in question. In addition to this, two farmers also mentioned the name "navalheiro", referring to the largest male of the family and with the largest canines. The interviewees who mentioned this name are farmers either with direct participation or with family members participating in the local hunting association, which may mean that this name may have been adopted by hunters to help identify the largest male and, consequently, the best trophy. No reference to this vernacular name was found in the IUCN Red List of Threatened Species, the Global Biodiversity Information Facility, or the íNaturalist, indicating that it is new to the scientific literature.

The high frequency of sightings of this species is not surprising, as wild boar populations seem to have increased in the last decades (Bosch et al., 2012; Massei et al., 2014) which in itself also increases the probability of spotting the species. In addition, we were told by the farmers these sightings occurred mostly on the road, when the ungulate crosses it, or on farmland that it visits to feed.

ii) Habitat, Behavior and Diet

When asked about the wild boar's habitat, the answers were divided into three categories: wooded areas, brambles, or along streams. In fact, the wild boar shows great plasticity, being able to live in various habitats and temperatures (Heptner et al., 1988; Sjarmidi & Gerard, 1988). However, the IUCN Red List of Threatened Species tells us that in Europe, the wild boar prefers mixed forests (composed of oak and beech) near meadows or swamps. In addition to this, the literature also mentions its presence in highly humanized habitats, such as the outskirts of cities, and in agricultural environments (Rosell et al., 2001). Thus, the answers given by farmers are in line with the literature

(Table 2), and the wild boar can even be found in all the response categories given: wooded areas are usually peripheral to brambles and small streams, all of which are habitats where wild boar can be found.

In regards to social organization, wild boars are gregarious animals, forming herds or sounders dominated by matriarchs and their young (Barrett, 1978; Keuling & Leus, 2019; Tack, 2018). Males abandon the herds starting at 8 months of age, thus becoming solitary adults. These only seek out females during the mating season (Marsan & Mattioli, 2013). Thus, since the social structure of wild boars is highly dynamic and active, it is understandable that farmers have some doubts on this point. Still, more than half (56%) identified the ungulate as a gregarious animal, agreeing with the literature (Table 2). The remaining 36% are divided between "solitary" and "can walk in groups or alone", which may have resulted from the fact that farmers have spotted only solitary males, in the first case, or have spotted, on different occasions, different social structures, in the second case.

This ungulate is mostly active during dusk and dawn, also exhibiting nocturnal activity (Keuling & Leus, 2019; Podgórski et al., 2013). More than half (63%) of the farmers gave a response in agreement with this, justifying it with the fact that the damage done by the wild boar occurs only at night, a time preferred by the ungulate due to the absence of humans on farmland. The remaining 36% gave a different answer to that given by the scientific literature (Table 2), with the majority saying that it could be both day and night and with one respondent saying that they were diurnal. As with the previous point, this is a product of the practical experience of the farmers: on one occasion they may have seen a wild boar during the day and, having no information to the contrary, assumed this to be true.

Regarding diet, the wild boar's diet is based on what is available to it at the moment, being, however, almost entirely composed of vegetable food: mast, roots, green plant matter and agricultural crops (Heptner et al., 1988; Schley & Roper, 2003; Spitz, 1986). Thus, all items mentioned by farmers (Table 1) are part of any of the 4 categories mentioned, with the exception of insects. However, the literature also refers the consumption of insects, arthropods, and mollusks by wild boars (Marsan & Mattioli, 2013; Schley & Roper, 2003) (Table 2). As this is an opportunistic and generalist animal, it is not surprising that the diet reported by farmers is vast and diverse: it results from the consumption of whatever is available to the ungulate at the time of feeding.

Table 2: Comparison between the answers given by farmers to questions regarding local ecological knowledge on various topics and the scientific literature.

Topics	Farmer's Answer	Scientific Literature
Habitat	"wooded areas" "brambles" "near streams"	In Europe, this species prefers "deciduous and mixed forests, preferably forests composed of oak and beech enclosing marshes and meadows" (Rosell et al., 2001).
Behavior (gregarious or solitary)	"prefers to walk in groups (3 or more animals)" "they can both walk alone and in groups" "they are solitary animals"	Wild boars are gregarious animals, forming herds or sounders (Tack, 2018). Adult males are usually solitary (Marsan & Mattioli, 2013).
Behavior (nocturnal or diurnal)	"it is a nocturnal animal" "it is more active at dusk and dawn" "the wild boar is diurnal" "it is active during both day and night"	This species is more active in the early hours of the morning or during twilight. It can exhibit nocturnal activity in areas of great disturbance (Keuling & Leus, 2019; Podgórski et al., 2013).
Diet	"Chestnut, maize, acorn, roots, common asphodel, Italian arum, walnuts, fruit, grass, insects, African wood-sorrel, root beet"	90% of the ungulate's diet consists of vegetable food from 1 of 4 categories: mast, roots, green plant matter and agricultural crops (Heptner et al., 1988; Schley & Roper, 2003; Spitz, 1986;). Insects are also common (Marsan & Mattioli, 2013; Schley & Roper, 2003).
Predators	"I don't think it has predators"	In Europe, the wild boar can suffer attacks from lynxes, bears and wolves (Heptner et al., 1988).
Hunting	"hunting is not allowed" "it is only allowed in the annual raids conducted by hunting associations" "it is allowed as long as the hunter had a license and permit"	In Portugal, hunting is allowed throughout the year (with some exceptions) in orderly hunting grounds, while in non-orderly hunting grounds, hunting can only take place between October and February (Decreto-Lei n.º 202/2004).
Conservation Status	"there are many and in excess" "there is an intermediate number of animals, I think there have been more"	Currently it is considered by IUCN Red List of Threatened Species as Least Concern (LC) (Keuling & Leus, 2019).

iii) Predators, Hunting and Conservation

In Portugal, the largest predator of wild boar is the Iberian wolf (*Canis lupus signatus*) (Table 2). However, the wolf population is quite weakened, being confined only to the north of the country, so the number of wild boars removed by the wolf is extremely small (Grupo Lobo, 2016; Jedrzejewski et al., 2000). Perhaps due to the fact that the wolf was not present in the study area, none of the interviewees mentioned the wolf as a possible predator, with over half of the farmers saying that the ungulate had no predators. Furthermore, when the researcher suggested the wolf as a predator, many of them did not believe that the wolf had the capacity to do so. This reveals a lack of information not only about the wild boar, but also about the wolf.

Wild boar hunting is allowed by law under certain conditions (Decree-Law No. 202/2004 of 18 August of the Ministry of Agriculture, Rural Development and Fisheries, 2004) (Table 2). In addition, the ICNF also allows wild boar population control measures to be carried out during the off-season (ICNF's Cinegetic and Aquaculture Resources Division, personal communication). This topic generated a lot of doubt, with 29% of respondents not knowing the answer, 12% saying it was not allowed, and the rest knowing only general details. This general lack of information may be due to the fact that hunting is seen as illegal and therefore almost taboo: no one knows when it happens, how it happens or how it should happen.

Finally, regarding the conservation status: the wild boar is currently considered by the IUCN Red List of Threatened Species as Least Concern (LC) due to, among others, its high abundance (Keuling & Leus, 2019) (Table 2). Thus, given the high damage caused and the frequency of sightings of the species, it is not surprising that almost all farmers are of the opinion that "there are too many wild boars, even too many".

3. Farmer’s Attitudes and Feelings

i) Frequency and Increase in Attacks on Farmers' Crops

Attacks on farmland occur throughout the year. Moreover, they occur several times, with farmers saying that they do not find a temporary pattern in the attacks: wild boars can either attack crops for a week at a time or go a month without appearing on the farmland. In addition, as one might expect, the attacks increase during the flowering and fruiting seasons (Thapa, 2010), but particularly during maize season: at this time, the boars seek

out the maize and can even destroy a maize field in a single night. Furthermore, it is also reported, both by farmers and literature (Thapa, 2010), that wild boar tends to return to their favorite crop lands, not giving up until they destroy all the maize present there. Lastly, it is also important to mention that the destruction also depends on the maturity of the maize, as already mentioned by other authors (Vassant, 1996): as mentioned above, wild boars only feed on maize when it is soft and not very ripe, "em leite". Finally, and although most said that the wild boar causes them damage all year round, there are a number of farmers who only reported damage during the maize season. This could have several explanations: they only plant maize; they do not plant other crops of interest to the wild boar, or the cropland where maize is not present is hardly accessible or even inaccessible to the wild boar: several studies show that the damage caused by wild boar is more intense near forest edges and streams, with the frequency of attacks decreasing the further away the field is from them (Cai et al., 2008; Linkie et al. 2007; Thurfjell et al., 2009).

To corroborate the fact that the number of attacks has increased in this area in recent years, it was asked if the frequency of attacks was increasing. The vast majority agreed, assigning different explanations: dam construction, abandoned farmland, high reproductive capacity, lack of hunting, introductions, lack of food for the animal, and forest fires. In fact, many of them are correct, and it is likely that the increase in attacks is the consequence of several of them together. A dam was built in 2015, which not only stole habitat from the wild boar, which meant that the ungulates ended up having to look for it closer to the farmland, but also food. In addition to this, the region has also been plagued by forest fires, which again destroyed habitat and food for the wild boar. All the above, together with the high reproductive capacity of the ungulate and a reduced number of raids (which have been suspended due to COVID-19), will certainly contribute to the wild boar seeking not only food but also refuge on and near farmland.

All this information helps us understand more about the attacks on agricultural crops made by wild boars in Portugal: they have a higher incidence in the maize season but occur throughout the year. They occur without a temporal pattern and can lead to the destruction of just one corn plant, or an entire land in one night. In addition, these attacks can increase in number and degree of destruction due to a myriad of conditions such as lack of food and habitat, high population numbers, crop type, and distance of the crops from forest and streams.

ii) Affected Crops and Monetary Losses

In Portugal, and even in years of abundant oak and beech seeds, wild boar still has agricultural crops as a large portion of their diet (Fruziński & Poznań, 2002; Fournier et al., 1996). Thus, it is not surprising that farmers have reported maize and potatoes as the most affected crops, as noted by other authors (Cai et al., 2008; Pandey et al., 2016). The preference for these particular crops may be due to three main reasons: firstly, these crops are rich in protein, carbohydrates, and mineral nutrients, making them more desirable compared to other wild plants (Sukumar, 1989); secondly, oak is not available from July to August, which leads to ungulates having to look for other food sources during this period, ending up feeding on agricultural crops (Calenge et al., 2004; Genov et al. 1995); in addition, this period also coincides with the ripening season of maize and potatoes, when they are juicier, contain more energy and are easier to digest (Cai et al, 2008; Schley & Roper 2003). This preference may also help explain the high damage caused by the wild boar: the wild boar scours the land for energy-rich foods that are at the optimal point of ripeness, preferring quality over quantity (Meinecke et al., 2018). This often causes it to trample down and destroy a large portion of cultivated land, even though it feeds little to nothing on the foods there: "the wild boar destroys more than what it eats". This happens both with the different farmlands and the grass lands and may also help explain the damage done to the stone walls, which will be torn down by the wild boar in search of food. Finally, regarding the damage caused to trees (fruit or otherwise): the farmers told us that it happens when they are still small and the type of damage described by those affected coincides with the behavior exhibited by the wild boar when marking territory (Allwin et al., 2016).

In line with this, and similarly to previous articles (Pandey et al., 2016), the destruction of maize and potato fields are indicated as the biggest monetary loss, and it is quite high for most farmers: the wild boar behavior already described above makes it so that sometimes the farmer's entire maize production for a certain year is destroyed in one night. Furthermore, as farmers say and as confirmed by the literature (Pandey et al., 2016), in most cases these crops, once trampled by the wild boar, can no longer be replanted, or fed to livestock. In cases where crops can still be replanted this often involves new monetary investment to buy new seeds, new labor, and for possible repairs to damaged infrastructure and machinery (Storie & Bell, 2016). All this has contributed to many farmers admitting that they have already stopped cultivating certain plots of land because for years on end the wild boar has been destroying all the crops planted there, as reported by Storie & Bell (2016) and van Aaken (1997).

When asked about the option of reporting these incidents, the vast majority not only do not know that they can do so but have never done it. This happens, as reported in previous studies (Ogra, 2009; Rohini et al., 2017) because the relationship between the public and authorities is not only of discredit, but even of conflict. Nowadays, cases of human-wildlife conflict are actually and mostly cases of human-human conflict, where the different stakeholders involved and their consequent interests are different, which causes them to clash (Frank et al., 2015). This ends up making the public not trust the authorities not only to help them, but also to represent them. In this particular case, the farmers feel abandoned and desperate, devoid of help and having to cope with all the damage by themselves. In fact, while explaining the purpose of the study and the interview, I was told more than once: "Good luck with your work, but I don't believe they will do anything with it. I hope so, but I don't believe it.". Added to this, farmers do not know who to report to and/or how to report: this information is not disseminated or communicated to the community, which means that even when informed that they could report to ICNF, the feeling of discredit remained. This feeling is further exacerbated by the cases of the few colleagues who did report incidents, but to no avail. Farmers feel abandoned.

iii) Damage Management Techniques and Solutions

Farmers use a wide variety of different techniques to try to keep wild boar off their land. From items that make loud noises, to devices with lights or objects with strong smells, the strategies are many. The most common is undoubtedly the implementation of fences. Almost half of the respondents use or have used them, and most are satisfied with their results. Even so, there are still a portion of farmers who say that they are not always effective. The vast majority admit that, as seen by other authors (Mayer & Brisbin, 2009; Tack, 2018) for fences to work, they need some initial investment to be well installed in order to be effective – in fact, fences imply not only initial investment but also maintenance, so they are indicated for small farmers, such as the interviewees (Mayer & Brisbin, 2009; Tack, 2018). However, even with small plots of land, many of the interviewees do not have the financial resources to buy the fencing, carry out the installation and do the maintenance. This means that those who do manage to install the fences do not always do so in the best way, and thus end up suffering, sooner or later, damage from wild boar again - this has contributed to farmers feeling desperate, as they see the investment in fencing as money wasted. The effectiveness of the other strategies is always low, as they only work until the wild boar gets used to them (Thapa, 2010).

Finally, there is still a large portion of farmers who do not resort to any measures, as they believe that nothing is effective and that spending money and time on them only adds to the losses already done by the boar.

For the vast majority of farmers, the solution to this problem is hunting, with almost all of them saying they are in favor of it, as also seen in previous work (Frank et al., 2015). The farmers asked for more regular and more intensive hunting, since, according to them, the local hunting association only conducts raids once a year and these have been suspended due to COVID-19. As seen earlier, recreational hunting alone is not enough to cause a reduction in population numbers - for this, it needs to be in line with management plans, and must also be combined with other measures (Keuling et al., 2016; Massei et al., 2014; Massei et al., 2011). Thus, it is to be expected that the hunting carried out by local hunters would not produce significant results in the numbers of the local populations. And it is precisely because of this that, as when asked about reporting the damage, respondents were suspicious and apprehensive about local hunters, saying that they did not believe they would be able to hunt any wild boar. Beyond this, some even suggested hunting with freer rules, so that the affected farmers can hunt the wild boar that cause them damage. Once again, the population feels frustrated and abandoned: the wild boar causes them harm, they can do nothing about it, and those who can, do nothing: "Nowadays animals have more rights than people! We can't kill them, but nobody does anything for us!". So, it is not surprising that the use of snares is still a common practice: farmers cling to what they can to defend their land. Adding to the hunting, other suggestions were also given as possible solutions, but they are, for the most part, impractical and/or would not lead to a resolution of the problem: for example, translocation of the animals, suggested by one farmer, would only cause the problem to be displaced, further increasing the damage in the destination region.

When given the choice between more regular and intensive hunting, monetary compensation for damage and a subsidy to help fence the land, almost three quarters of the respondents chose hunting. In fact, hunting has several points in its favor that make farmers prefer it: firstly, if it were followed in a way that would reduce population numbers, it would be a solution to help everyone and in all fields where wild boar have a negative impact; secondly, and again assuming it would be applied and followed continuously, it would be a permanent solution; thirdly; it does not involve any extra work or investment for farmers; and lastly, it does not involve being dependent on monetary compensation, which many farmers believe would never even come. Beyond this, the truth is that farmers do

not see the wild boar as a necessary, beneficial, and/or valuable animal, and they do not find hunting the ungulate emotionally upsetting. A portion of farmers say they prefer the subsidy to help fence, as they admit that with more money available, they would have an easier time erecting a safe, wild boar-proof fence. Only three respondents would prefer financial compensation, and there is general agreement that this type of measure would never be fulfilled, and if it were, it would never be a fair amount. In fact, the literature shows us that these types of cases are quite common: Rohini et al. (2017) shows us that more than half of the public who have applied for compensation say that these types of measures are ineffective, since compensation is low, the process of filing a claim is slow and difficult, and there is a general distrust of these types of programs. In addition to this, there are also losses that are not covered by the compensation program (Ogra & Badola, 2008). Similar results are also presented by other authors (Frank et al., 2015; Ogra & Badola, 2008; Ogra, 2009). It has been reported that insufficient compensation leads to people being more reluctant to participate in these types of measures (Spiteri & Nepal, 2008), and together with a delay in receiving compensation, these are crucial factors in the decision to carry out retaliatory attacks by the local community (Wakoli & Sitati, 2012). In fact, prompt and timely payment can help improve people's perception, even if the payment is low (Rohini et al., 2017). In addition to this, if those affected are forced to bear the cost of wildlife damage, local support for conservation will surely decrease (Woodroffe et al. 2005; West et al. 2006). Lastly, it is also important to note that these last two types of measures (subsidy and compensation) do not address the stress and heartbreak that farmers go through, as indicated by respondents and as noted in previous studies (Bulte & Rondeau, 2005; Hoare 1995).

It was at this point that some theories emerged: some have suggested that the wild boars were bred on farms and only then released into the wild (hence their inclination to go and eat and destroy the maize), with farmers even saying that the wild boars were microchipped before being released, so that in the event of it being hunted illegally, the authorities could find it and fine the culprit. There is also a general belief that ungulates were introduced to the area. As previously stated, the introduction or reintroduction of wild boar in Portugal is prohibited by law, as are wild boar breeding farms, and no wild boar is microchipped (ICNF's Cinegetic and Aquaculture Resources Division, verbal communication). These theories demonstrate a lack of information on the part of farmers, who, not knowing how to justify the high population numbers, try to find justifications with the poor information available to them. This has contributed to the spread of

misinformation and to the feeling of helplessness, despair and injustice growing even more.

iv) Conservation

More than half of the farmers stated without hesitation that they want the wild boar exterminated, saying things like "what is it doing here?". Similar results have been reported by other authors (Wang et al., 2006), where a similarly high portion of respondents advocated extermination of problematic wildlife. In other cases (Li et al., 2010), there is a minority choosing this option, with the majority choosing to "control" the wild boar. In the case of this study, the remaining respondents who do not call for extinction of the wild boar choose to decrease population numbers of the ungulate. This difference between the two types of groups (the group asking for immediate extermination and the group asking for the reduction of wild boar numbers with the aim of finding a solution) could be explained by different factors: respondents with a higher level of education have more positive attitudes towards wild boar (Bremner & Park, 2007; Wang et al., 2006), as do those who have jobs other than farming (Li et al., 2010) and those who have smaller farmlands (Naughton-Treves, 1997). Only 10 respondents advocated for the conservation of wild boar in cases of conflict, and only in cases where the damage caused is minimized. This type of result, where conservation is accepted only in exchange for a reduction of conflict, is also found by other authors (Li et al., 2010). These respondents are the ones who argue that no species should be driven to extinction and that a solution should be sought that is ideal for all parties involved. It is perceptible that there is a lack of empathy and connection to this species of ungulate, combined with a great lack of knowledge about its ecology. In fact, almost all respondents say they see no benefit in the presence and existence of the wild boar. Li et al. (2010) and Storie & Bell (2016), obtained similar results: farmers only see the wild boar as synonymous with damage and lost money. The remaining 4 farmers who said they see benefits in the wild boar cannot identify them, which again shows the lack of knowledge around the ungulate. The truth is that literature also tends to focus more often on the negative aspects of the wild boar (Barrios-Garcia & Ballari, 2012): after all, as human beings we always end up giving more importance to the negative aspects than the positive ones. However, it is not fair or correct to give the role of villain to the wild boar when, at the same time that it brings problems, it also brings many benefits: creation of new habitats and germination niches (Kotanen, 1995; Sandom, 2010), provides the opportunity for pioneer species to re-establish

themselves (Sandom et al., 2012), has a critical influence on plant community dynamics (White & Jentsch 2004; Gordon & Prins 2008), is a key stone species in trophic chains (Heptner et al., 1988), is involved in symbiotic relationships (Barber & Morris, 1980; Kilham, 1982), among others. Thus, it is important to change the narrative regarding wild boar so that its benefits become as or more important than the disadvantages associated with it.

Final considerations

The wild boar continues to be synonymous with damage, plague, and harm. Indeed, this is even apparent from the media coverage of the species: negative news reports are published four times more often than positive ones, with the most frequently covered topic being the fear that the species will attack people, even though this is extremely rare (Goulding & Roper, 2002). This bad reputation that accompanies the ungulate makes the success of conservation efforts increasingly low - but not impossible. It is crucial to combat misinformation and involve those affected in the process, while simultaneously implementing effective measures that every party agrees on. To this end, I propose a multidisciplinary plan with diverse approaches.

The truth is that there is no one solution fits-all: each case will require an independent analysis and therefore a unique solution tailored to all stakeholders involved. In addition, we have also seen that there is no single solution that can, by itself, solve the conflict. Thus, what we propose is the use of a set of different solutions, which should be discussed and chosen by all parties involved, and which should complement each other in order to tackle the problem effectively and satisfactorily. It is important that there is some plasticity in this approach: while for a certain area where, for example, the conflict is not so intense, the application of preventive measures will suffice, in another area, where there is a high level of conflict, it may already make sense to apply measures to remove the ungulate - again, the case in question must be analyzed and the measure or measures must be discussed by all parties involved with the aim of reaching a consensus that not only pleases everyone, but also brings results. In addition, it is also essential to note that the process of choosing and applying measures should be renewed and dynamic: measures that make sense today, may no longer make sense in a year's time - the solutions chosen should be reviewed and renewed, if it makes sense, frequently. We therefore propose some measures that can be used in different degrees of conflict. From a point of view of the use of lethal measures, it is important to mention hunting: hunting is undeniably an essential strategy for wild boar control, being one of the most effective methods for ungulate population control (Beskardes et al., 2010). However, as seen before, recreational hunting alone is not enough to reduce population numbers, being responsible for a mortality rate of only 31% (Nores et al., 2008; Massei et al., 2014), when 55 to 70% of the population would have to be removed in order to suppress population growth (Keuling et al., 2013). Accordingly, it would also be crucial to carry out a census of the wild boar population in Portugal, so that appropriate hunting quotas can be set in order to reduce population numbers. Thus, hunting can and should be paired with other non-

lethal methods, such as fencing or administering contraception. The use of fences serves as a physical barrier that prevents ungulates from gaining access to areas of economic and environmental value and are an alternative for areas where the use of lethal measures is not as effective. These fences must be "wild boar-proof" to be efficient and may require some maintenance, but are a measure that farmers are already familiar with and readily accept. Regarding sterilizations, is a measure to be used, like fencing, in cases of difficulty in applying lethal measures or even as a complement to them. Although a more practical and realistic version is still being sought, the effectiveness of such measures is promising (Campbell et al., 2010; Killian et al., 2006; Massei et al., 2012). Furthermore, several studies show that a combination of certain levels of sterilization and hunting can lead to the achievement of a regulated population in just 4 years, and that this combination is more effective than hunting alone (Croft et al., 2020). In addition, it is also important to consider the only natural predator of the wild boar in Portugal: the Iberian wolf (*Canis lupus signatus*) (Grupo Lobo, 2016). Ideally, the removal of the wild boar would be done by the predator in a natural way and without any anthropogenic influence or pressure. However, as shown by the literature (Jędrzejewski et al., 2000; Nores et. al, 2008), it is not realistic to expect that wolf predation will be sufficient to cause a significant reduction in wild boar populations, which are themselves abundant: in the Iberian Peninsula, although the wolf specializes in cervids, it prefers roe deer (*Capreolus capreolus*), with wild boar appearing only as second or third prey, depending on the area and season (Barja, 2009; Figueiredo et al., 2020). In addition, as already mentioned, Iberian wolf populations remain quite fragile in the Iberian Peninsula (Grupo Lobo, 2016; Jedrzejewski et al., 2000), which makes a possible population reduction of the ungulate as a result of wolf predation even more unlikely and difficult to achieve. However, it is a great solution to consider: the recovery of Iberian wolf populations would be in part supported by wild boar populations, which in turn would reduce with the presence and predation of the predator. However, as it is a solution to be acquired in the long term and will take time to show results, it could be complemented with any of the solutions mentioned above.

To coordinate all these possible management measures, we would also suggest the creation of institutions/organizations that have as their main goal the reduction of conflict with wildlife, as suggested by Ogra (2009). Ninety four percent (94%) of those affected by the conflict with wildlife say they would be willing to collaborate in a cooperative management institution such as the one suggested. However, most say they do not believe they would be effective because their voices are not heard (Ogra, 2009). Therefore, it is important to counter these opinions and show those affected that their

voices are not only heard, but also considered and implemented. Thus, these institutions would consist of elements from the various stakeholder groups and would be responsible for holding periodic meetings where the local public could present its ideas and thus propose solutions to the most varied cases of conflict. This would help those affected to feel heard and integrated, thus increasing the acceptance of conservation measures (Frank et al., 2015). In addition to this, these organizations would also serve to make the complaint and compensation claim process (in case the chosen complementary measures entail this type of process) not only faster, but also easier and more accessible, since there would be a stage dedicated to explaining the whole process and what the rights and duties of those affected are. Finally, these would also serve as a help station where farmers could seek help and assistance for a wide variety of problems related to the wildlife conflict. All of this would have to be accompanied with training for the staff responsible for assisting the public in order to improve the communication process between the two parties, which in turn would increase trust and transparency towards the entities (Rohini et al., 2017). Thus, these organizations would serve to give greater accountability to those affected, leading them to increase their contribution and, consequently, acceptance of conservation, making us all (general public, wildlife managers, and authorities) work as a team towards the same end: wildlife conservation.

Lastly, it is also important to mention the importance of education. Education is an indispensable asset when it comes to wildlife conservation: as seen before, individuals with a lower level of education are usually associated with more negative attitudes towards wildlife. Our work shows, precisely, that in our study area, the local ecological knowledge presented by the population still falls short. There are certain topics, such as habitat, behavior, and diet, where there are already a majority of correct answers. However, on topics such as predators, hunting and conservation, the information is still wrong or even non-existent. This made it easy to identify "information gaps" that need to be filled in and the presence (or lack thereof) of incorrect information. Thus, it is extremely important to focus on educating and raising awareness among the population to combat this information gaps and incorrect information: it is counterproductive to apply wildlife management strategies if the people with whom wildlife comes into contact with on a daily basis do not understand and advocate for wildlife conservation - so there should be no management without raising awareness among farmers, hunters, and the general population. This will certainly contribute to the population becoming more interested and better informed, and to the extinction of some theories (which result, precisely, from lack of information) that only contribute to make farmers feel angrier and more abandoned.

Still, and considering that ethnobiology is a growing area, there is some future work to be developed. It would be important, as suggested by Frank et al. (2015), to test which is the best tool (social networks, local newspapers, etc.) and the best communication strategies (posters, public meetings, pamphlets, etc.) for sharing information with those affected. In addition, it is also suggested to test which entity would be best used for information sharing (local politicians, local authorities, scientists, etc.). All these points should also be tested on the best way to raise awareness and educate the population in order to combat misinformation: what is the best tool (reading material, videos, pamphlets, etc.), the best communication strategy (lectures, conversation groups, field trips, etc.), and the best entity (local politicians, local authorities, scientists, etc.) to achieve a more informed population that supports and accepts wildlife conservation. In addition, it is also important to continue to develop management techniques for the wild boar, which are still few and ineffective: it is important to continue to work on contraception, so that it becomes as effective as possible, and it would also be interesting to create a non-toxic and non-lethal repellent capable of keeping wild boars away and without harmful effects on the ecosystem.

Using a multidisciplinary plan with diverse approaches, we guarantee not only that all stakeholders are heard and involved in the process, but also that each community, together with the competent and specialized authorities, chooses and defines the solution that best fits its situation, always with flexibility for changes when this solution no longer makes sense. All of this will help the communities feel that they are being listened to, and that the tension between the authorities and the population will disappear and be replaced by a climate of cooperation and unity. In addition, it will also help authorities to stop applying measures in vain and with little or no results, being replaced by realistic measures that will contribute to the population's relationship with wildlife moving from one of conflict to one of respect and admiration.

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Additional Files

Additional File 1 - Statement of Informed Consent

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Caro Senhor(a),

O meu nome é Vitória Margarida Ribeiro Fontora, sou estudante da Universidade de Aveiro e estou a fazer um estudo sobre o a destruição das culturas agrícolas pelo javali em Oliveira de Frades. Essa pesquisa pretende perceber qual as culturas mais afetadas, as condições em que tal acontece e como é que os agricultores se sentem em relação a essa destruição e o que fazem para o evitar. Para além disso, irei também recolher o conhecimento geral que os agricultores têm sobre o javali.

Para a realização da pesquisa preciso de conversar e entrevistar alguns agricultores em Oliveira de Frades. Se se sentir à vontade para colaborar com nossa pesquisa, irei fazer algumas perguntas simples sobre o javali e recolher a sua opinião relativamente à destruição que este provoca**.** Se o permitir, as entrevistas serão gravadas, sendo que essas gravações servirão para facilitar o acesso à informação, mais tarde. A sua identidade será mantida em anonimato e apenas usarei as suas respostas. No entanto, se assim permitir, irei recolher e anotar o seu nome para o caso de ser necessário entrevistá-lo novamente. Se mudar de ideias e quiser desistir, pode fazê-lo em qualquer altura e sem qualquer consequência. A sua opinião será muito importante para o nosso estudo, pois os dados reunidos nas entrevistas poderão contribuir para o conhecimento ecológico local sobre o javali e para que a conservação do javali seja feita de forma correta de maneira que o conflito com os agricultores seja diminuído ou erradicado. As informações recolhidas irão fazer parte de um trabalho que poderá ser publicado em revistas científicas e de um relatório a entregar na Universidade de Aveiro. Caso concorde em participar, peço-lhe que assine este termo de consentimento, que também será assinado por mim, a investigadora responsável. Qualquer dúvida que tenha, sinta-se convidado a perguntar. O meu endereço de trabalho é: Departamento de Biologia & CESAM, Universidade de Aveiro. Campus Universitário de Santiago, 3810-193 Aveiro; telemóvel: +351 925 205 052; e-mail: vitoriafontora@ua.pt

Eu, _____, idade: ____, aceito participar na pesquisa intitulada

“O javali e os agricultores: o uso de conhecimento ecológico local para mitigar o conflito causado pela destruição de culturas agrícolas”, tendo sido devidamente informado e esclarecido, como disposto acima.

_____

_____ Vitória Fontora (Investigadora Responsável)

Assinatura do voluntário

_____, ___ / ___ / ___

A rogo do Sr(a)_____, assinam:

_____

_____

Assinatura da Testemunha 1 Assinatura da Testemunha 2

Additional File 2 - Interview Script

Data:

Nº da Entrevista:

Antes da entrevista, é lida a Declaração de Consentimento.

Parte I. Parâmetros Sociodemográficos dos Agricultores

1 – Nome ou alcunha (opcional):

2 – Onde vive?

3 – Idade:

4 – Nível de educação: ( ) Baixo [iletrado ou escola primária (1º até ao 5º ano)]; ( ) Básico [escola elementar (6º até ao 9º ano); ( ) Intermédio [secundário (10º até ao 12º)].; ( ) Alto [ensino superior].

5 – Fonte de rendimento mensal?

5.2. – Sendo agricultor secundário, retira algum rendimento dessa atividade ou apenas cultiva para uso próprio?

6 – Há quanto tempo é agricultor? Ainda o é atualmente?

7 – Que tipo de cultivos tem?

8 – Quanto tempo dedica diariamente à agricultura?

9 – As suas terras de cultivo estão vedadas ou cercadas?

É mostrada uma ilustração/foto de um javali.

Parte II. Conhecimento ecológico local dos agricultores sobre o javali

1 – Qual o nome comum desta espécie?

2 – Onde é que o javali vive? Qual é o seu habitat?

3 – Costuma ver/cruzar-se com javalis?

4 – Vive em grupos ou é solitário?

5 – É um animal diurno ou noturno?

6 – Alimenta-se do quê?

7 – O javali serve de presa a que animais?

8 – A caça ao javali é permitida? Quando?

9 – Qual acha que é o estado de conservação do javali? Há muitos ou poucos?

Parte III. Atitudes sobre o conflito, os danos causados pelo mesmo e a consequente necessidade de conservação do javali

1 – Alguma vez as suas culturas foram destruídas pelo javali? É recorrente? Quantas vezes por ano? Em que meses normalmente acontece?

2 – Dizem-me que o número de ataques tem vindo a aumentar nos últimos anos. Porque acha que isso acontece?

3 – Quais foram as culturas que foram destruídas? São destruídas sempre as mesmas? Eles destroem e comem as culturas, ou mexem só a terra?

3 – Tem perdas monetárias associadas a esses ataques? São elevadas?

4 – Como procedeu nesses casos? Reportou às autoridades?

6 – O que acha que leva a que os javalis destruam as suas terras de cultivo?

7 – Usa alguma medida para evitar estes ataques (p. ex.: cão de guarda, fitas, cercas)? Essas medidas ajudaram a diminuir os ataques?

8 – Na sua opinião, qual pode ser a solução para estes ataques?

9 – Concorda com a caça ao javali?

10 – Gostava que o número de javalis diminuíssem, se mantivessem ou aumentassem?

11 – O que acha adequado como indemnização para os ataques? Gostaria de receber compensação monetária? Que o estado contribuíssem para a vedação dos terrenos?

12 – Sabia que pode fazer queixa sobre os ataques e que o ICNF vem fazer caça ao javali na zona?

13 – Devemos conservar o javali mesmo que ele continue a destruir culturas?

14 – Acha que o javali traz algum benefício?