Universidade de Aveiro Departamento de Biologia
Ano 2019

Raquel Sofia Costa Martins

Managing wolf conflict perspectives in central Portugal

Atitudes e perspectivas de conflitos com o Lobo no centro de Portugal

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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 da Doutora Rita Maria Tinoco da Silva Torres, Investigadora do Centro de Estudos do Ambiente e do Mar (CESAM) da Universidade de Aveiro e do co-orientador Doutor Luís Miguel do Carmo Rosalino, Professor Auxiliar Convidado do Departamento de Biologia Animal da Faculdade de Ciências da Universidade de Lisboa.

Dedico este trabalho aos meus pais, por tudo que me proporcionaram.

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Presidente	Prof. Doutora Maria Helena Abreu Silva Professora Auxiliar do Departamento de Biologia da Universidade de Aveiro
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palavras-chave

Lobo-ibérico, *Canis lupus signatus*, conflito Homem-Lobo, Atitude, Medo, Conhecimento, gestão da vida selvagem

resumo

Durante o século XX, a população portuguesa de lobos sofreu um decréscimo devido à expansão rodoviária, aumento de fogos florestais, diminuição de presas selvagens e à perseguição humana. Isto é particularmente preocupante no centro de Portugal, a sul do rio Douro, onde as populações são pequenas, altamente fragmentadas e isoladas, com baixa variabilidade genética e reprodução instável e baixa densidade de presas selvagens. Nesta área, os conflitos são agravados devido aos altos níveis de predação a gado doméstico, que constitui mais de 90% da dieta dos lobos. Este tipo de comportamentos dificulta as interações entre os humanos e a vida selvagem, instigando muitas vezes, comportamentos como a caça ilegal ou envenenamento para solucionar o “problema”, sendo esta a principal causa de perseguição e decréscimo das populações de grandes carnívoros. Avaliando as atitudes individuais para com o lobo no centro de Portugal, acreditamos ser possível perceber e prever comportamentos para com a espécie. Recorremos a um questionário para amostrar a população local, um total de 222 questionários de três grupos alvo (publico geral, N= 119; donos de gado, N= 88; e caçadores, N= 24) foram analisados. Medimos os Índices de Atitude, Medo e Conhecimento, testamos a correlação entre índices e examinamos quais as variáveis que influenciavam as Atitudes e o Medo. As atitudes para com o lobo são positivas, apesar do índice de Medo ser elevado e o Conhecimento baixo. Também descobrimos que as atitudes tendem a ser mais positivas quando o medo é baixo e o conhecimento alto. As principais variáveis que influenciam as atitudes negativamente são o medo e a idade no caso dos donos de gado, em que pessoas mais velhas que 60 anos tinham atitudes negativas. Em relação ao medo, as principais variáveis que o influenciam são pessoas do género feminino, o baixo índice de conhecimento e ter conhecimento/sofrido ataques a gado doméstico. Estes resultados podem ser utilizados para aumentar a tolerâncias dos locais, criando medidas conservacionista personalizadas em conjunto com todos os grupos de interesse.

keywords

Iberian Wolf, *Canis lupus signatus*, Man-Wolf Conflict, Attitude, Fear, Knowledge, Wildlife Management

abstract

Portuguese wolf populations suffered a decrease during the 20th century mainly due to the expansion of road network, increasing number of forest fires, decrease of wild prey populations, and human persecution. This is particularly worrying in Central Portugal, South of River Douro, where populations are small, highly fragmented and isolated, with little genetic variability and instable reproduction, and low density of wild prey. Conflict in this area is aggravated by high levels of livestock depredation, where livestock makes up for more than 90% of wolves diet. This antagonizes Humans towards wildlife, that typically respond by recurring to activities such as illegal pouching or poisoning in order to solve their problem. This problematic is recognized as the first cause of large carnivores' persecution and population decline. By surveying individual attitudes toward wolves in central Portugal, we believe that it is possible to understand and even predict behaviour towards the specie. This was done using a questionnaire to sample local population, a total of 222 questionnaires from three interest groups (general public, N=119; livestock owners, N=88; and hunters, N=24) were analysed. We measured Attitude, Fear and Knowledge Index, tested correlation between Index and examined which variables influenced Attitudes and Fear. Attitudes towards wolves were positive, even though Fear high and Knowledge was low. We also found that attitudes tend to be more positive with the decrease of fear and the increase of knowledge, and fear tends to decrease with the increase of knowledge. The main variable influencing attitudes negatively was found to be Fear, and age for the livestock owners, where people older than 60 years old tend to have more negative attitude. As for Fear the main influenceable variables belong to the female gender, a low knowledge index and the knowledge/having suffered from wolf depredation. These results can be used to increase locals' tolerance, by creating tailored conservational measures together with all the stakeholders' group.

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Introduction

1.1. Large carnivores' trends in Europe and Human perceptions

The 19th century Industrial Revolution resulted in a widespread rural exodus, and consequently lead to the abandonment of traditional rural livelihood in favour of a new industrialized civilization (Chauchard *et al.* 2007; Navarro and Pereira 2015; Lasanta *et al.* 2017). The abandonment of agricultural land, more pronounced in mountain areas, created an opportunity for forest and shrublands colonization (Chauchard *et al.* 2007; Nunes *et al.* 2011; Lasanta *et al.* 2017), which created new opportunities and adequate habitat for the establishment of large carnivores (Chapron *et al.* 2014; Navarro and Pereira 2015). In Europe, an increase in scientific knowledge and the worldwide escalation of the Environmental Movement (global movement combining organizations, governments, scientists and civil society, concerned with nature protection and conservation (McCormick 1991; Khondker 2015) occurred in the second half of the 20th century and in the beginning of the 21st. That increased awareness led to the implementation of a wide range of nature conservation policies, regulating hunting and wildlife protection, especially promoted by the European Union. This combination of factors aligned with the increase of wild ungulates in both range and numbers, formed the perfect environment for the expansion of large carnivores populations in this continent (Chapron *et al.* 2014; Kopatz *et al.* 2014; Navarro and Pereira 2015).

There is evidence that large carnivore populations are expanding in Europe (Chapron *et al.* 2014) and the recovery of brown bears (*Ursus arctos*) populations is one of the most successful examples of the mentioned recovery trend. According to data from 1950-1970's, bears were estimated to occur in 18 European countries, with approximately 4.000 individuals. Currently, they have expanded their territories, inhabiting 23 European countries with an estimated population of approximately 17.000 individuals, being the most abundant large carnivore in Europe (Chapron *et al.* 2014; Boitani and Linnell 2015; LCIE 2019). The majority of brown bears populations are stable or increasing, except for the populations located in the Scandinavian region, that are currently decreasing (LCIE 2019). Legally, they are protected under "The Habitats Directive", Annex IV (Boitani and

Linnell 2015), although hunting is permitted for some specific situations (Kaczensky *et al.* 2004).

A similar pattern has been described for Eurasian lynxes (*Lynx lynx*). Until 1970's lynxes had become extinct from almost half of their original area of distribution, with a range restricted to 13 countries, with an effective of approximately 1.100 individuals. During the 70-80's, they were reintroduced in 11 central European countries (France, Switzerland, Italy, Austria, Germany, Slovenia, Czech, Bosnia-Herzegovina, Croatia, Hungary and Bulgaria) (Chapron *et al.* 2014; Müller *et al.* 2014; Boitani and Linnell 2015; LCIE 2019). Currently, they inhabit 23 countries, with approximately 9.000 individuals, and most of their populations are stable (Chapron *et al.* 2014; Boitani and Linnell 2015; LCIE 2019), except for the Scandinavian, Baltic, Dinaric (reintroduced) and Vosges-Palatinian (reintroduced) populations (Chapron *et al.* 2014; LCIE 2019). They are also protected under the Habitats Directive Annex IV, except in Estonia, where they are in Annex II, allowing their management for recreational hunting (Boitani and Linnell 2015).

Wolverine (*Gulo gulo*) had the lowest distribution area (247.900 km^2), inhabiting only the region known as Fennoscandia (Norway, Sweden and Finland) (Chapron *et al.* 2014; LCIE 2019). Although their numbers have increased from 530 individuals (50-70's) to 1.250 (2016), only two populations remain. Their overall population tendency are similar to the previous species, except for the Scandinavian population, which is currently decreasing (Chapron *et al.* 2014; LCIE 2019).

Grey wolves (*Canis lupus*) currently inhabit 28 countries and are the second most abundant species of large carnivores present in Europe, with approximately 17.000 individuals (LCIE 2019). Even though most populations are stable or increasing, the tendency for the NW Iberian and Dinaric-Balkan populations are unknown (Chapron *et al.* 2014; Boitani and Linnell 2015; LCIE 2019). The most endangered population is located in Sierra Morena, southern Spain, where during the 2013-2014 census no pack was detected, rendering the population virtually extinct (López-Bao *et al.* 2018; LCIE 2019). Similar to bear and lynx, wolves are protected under the Article 16 of Habitats Directive, by Annex II and IV, although some countries authorized regulated hunting, under Annex V. Contrary to the

Eurasian lynx, there has never been reintroductions of wolves anywhere in Europe (Boitani and Linnell 2015).

The increase in carnivore populations can be positive for the environment, not only through a rewilding perspective, but also to balance ecosystems. As top predators, large carnivores influence wild species densities - specially ungulates and mesopredators - decrease zoonotic disease propagation, impact vegetation growth, and can even alter stream morphology (Ripple *et al.* 2014; O'Bryan *et al.* 2018). Although, Europe is a small continent highly affected by human activity, the impact or role of large carnivores in these humanized environments is still uncertain (Kuijper *et al.* 2016). Nevertheless, this population increase was possible, not only as result of intense legislative protection, rural exodus, and forest and shrubland increase (Chapron *et al.* 2014), but also due to carnivores' tolerance to human presence (Sunde *et al.* 1998; Linnell *et al.* 2001; Jędrzejewski *et al.* 2004; Boitani and Linnell 2015; Bouyer *et al.* 2015; Kuijper *et al.* 2016). Predominantly associated with the ideal of wilderness, carnivores are depicting increasing tolerance to human presence, adapting their behaviour to live in areas densely populated by Humans. Several examples have been highlighted throughout the Continent: Eurasian lynx have colonized areas in the periphery of the urban city of Oslo, Norway (Bouyer *et al.* 2015); Italian wolves have adapted to feed from garbage dumps (Boitani 1992); in Servia, Golden Jackals (*Canis aureu*) scavenger behaviour saves the government around >0.5 million € per year by providing the service of removing animal carcasses from the environment (Ćirović *et al.* 2016). More examples like these can be seen through Europe, where proximity to humans often results in close encounters or contact with human activity (i.e. agricultural lands, livestock grazing). Even though some can see the possibility of an encounter as a positive outcome, such a local increase in revenue due to ecotourism (Conforti and De Azevedo 2003; Carter *et al.* 2012), generally, co-existence is a controversial subject where the species negative impact and/or peoples negative perceptions of carnivores often leads to conflict (Romañach *et al.* 2007; Zimmermann *et al.* 2010; Chapron *et al.* 2014; Kuijper *et al.* 2016). This conflict is the main reason for large carnivores' persecution and population decline, instigating activities such as illegal poaching and poisoning (Lindsey *et al.* 2005;

Michalski *et al.* 2006; Karlsson and Sjöström 2007; Lucherini and Merino 2008; Anand and Radhakrishna 2017).

But what is a conflict? The Cambridge Dictionary (2019) defines it as "an active disagreement between people with opposing opinions or principles; fighting between two or more groups of people or countries". For the specific case of Human-Wildlife, conflict is more complicated to define. For Frank (2016), "Conflict can be ascribed to wildlife impacting humans, humans impacting wildlife, and conflicts between humans over wildlife". This concept is of great importance because it defends that conflict arises from humans due to animals not being conscious competitors. While the presence of apex predators can be beneficial, humans and wildlife interactions are generally reported through a negative perspective. Normally, the focus tends to be directed to how wildlife can impact humans directly, leading to economic loss (by livestock depredation, crop damage, decrease of game populations and property damage), decrease the general sense of security, injuries due to direct attack to humans (bite or claw), road collisions or transmission of zoonotic diseases (Conforti and De Azevedo 2003; Osborn and Hill 2005; Michalski *et al.* 2006; Karlsson and Sjöström 2007; Bath *et al.* 2008; Lucherini and Merino 2008; Linnell *et al.* 2010; Frank 2016; Nyhus 2016; Anand and Radhakrishna 2017). However, wildlife can also have an indirect effect on human populations, such as farmers increased expenses to protect livestock (e.g. fences installation, maintaining shepherd dogs, reduce conception rates, limited grazing area, etc.), livelihood development restrictions and decrease of physical and psychological conditions (Ogra 2008; Ogra and Badola 2008; Linnell *et al.* 2010; Steele *et al.* 2013; Kansky and Knight 2014; Nyhus 2016).

In ecology, scientists tend to focus on organisms and their interactions with the environment, usually overlooking the effect or impact of human dimension. This approach is starting to change with the increasing incorporation of social sciences in ecology. Scientists began to question the currently used terminology when referring to conflict, i.e. Human-Wildlife conflict. The main problem raised by some scientists, is the notion of the word conflict portraits wildlife as a conscient being, willingly to engage in conflicts with human interests (Peterson *et al.* 2010), damaging/constraining humans perceptions

regarding wildlife (Redpath *et al.* 2015). Animal impacts occur mainly due to competition for resources, not to deliberately cause harm or financial loss to humans, meaning that this subject is more complex than solemnly description of conflict and the direct impact of human over wildlife or *vice-versa* (Peterson *et al.* 2010; Pooley *et al.* 2017). A more humancentric version of conflict is being adapted, defending that conflict arises from conflict of interests between different human/stakeholder groups, i.e. those that seek animal conservation and those that hold other intentions (Redpath *et al.* 2013; Pooley *et al.* 2017). Human motivation can be based on cognitive level, attitudes, social values and cultural history (Dickman 2010; Peterson *et al.* 2010; Redpath *et al.* 2013; Pooley *et al.* 2017). Therefore, by refraining the terminology *human-wildlife conflict* in favour of *human-wildlife impacts* and *human-human conflicts*, scientists are trying to change the negative association of conflict to wildlife, onto the divergent interests of human groups (Peterson *et al.* 2010). Some authors prefer to use the term *human-wildlife interactions* to promote a more neutral feeling towards the thematic (Morzillo *et al.* 2014)

Humans have the power to deeply shape nature and are considered the reason why many species became extinct (Folke *et al.* 1996; Lyle 1999; Ceballos *et al.* 2015). So in order to understand conflict, it is necessary to adopt a more sociological approach (Kleiven *et al.* 2004; Treves *et al.* 2006; Bath *et al.* 2008), a common practice in North America, but only recently implemented in Europe (Bath *et al.* 2008). One of the approaches used to asses sociological drivers of human-wildlife interactions is surveying human attitudes towards wildlife (Bruskotter and Wilson 2014). Several studies have showed that attitudes (defined as *a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour*; Eagly and Chaiken 2007) can be used as indicators of tolerance, being influenced by sociodemographic factors, but also by politics, economy, social and cultural believes, traditions and mistrust (Kleiven *et al.* 2004; Madden 2004; Michalski *et al.* 2006; Bruskotter and Wilson 2014; Hill 2015). Some even demonstrated that close contact, or inhabiting areas near carnivores, can greatly impact human attitudes, i.e. people living in urban areas more distant of wildlife tend to be more acceptant and tolerant towards wildlife than those living in rural areas in close proximity to the animals (Conforti and De Azevedo 2003; Kleiven *et al.* 2004; Karlsson and Sjöström 2007; Majić *et*

al. 2011). Older people (Kleiven *et al.* 2004), farmers and hunters (Bath *et al.* 2008; Majić *et al.* 2011; Dressel *et al.* 2015) tended to be more intolerant towards large carnivores. Europe is called the old continent, possessing a rich culture in tradition and folklore connected to nature, which ultimately is reflected in the attitudes of their habitants (Kleiven *et al.* 2004; Madden 2004; Majić *et al.* 2011; Dressel *et al.* 2015; Frank 2016). When dealing with attitudes, scientists also have to take into account populations' cultural background. The incorporation of cultural assessments, although often overlooked, is important mainly due to its' power to influence and shape how someone feels towards a subject, i.e. cultural tradition of wildlife preservation or negative myths and stories heard during childhood.

European attitude studies tend to focus mostly on three carnivore species, brown bear, Eurasian lynx and grey wolves, where the attitudes towards bears and wolves are usually more negative (Kleiven *et al.* 2004). Both species are linked to highest levels of conflict associated with more negatives attitudes from people (Kleiven *et al.* 2004; Boitani and Linnell 2015). The recent recolonization by these species of many areas of Europe where they were previously extinct, fostered and enhanced conflicts (Chapron *et al.* 2014; Boitani and Linnell 2015), which was aggravated by growing negative interactions with human activity and, consequently, economic damage (Kleiven *et al.* 2004; Dressel *et al.* 2015).

The wolf is one of the carnivore most well adapted to human-dominated areas, having the widest range in Europe (Chapron *et al.* 2014). Some populations have adapted to the presence of humans by changing active periods for night-time and foggy weather, learned to enter settlements and cities stealthily searching for food, cross highways, railroads and industrial areas, even to inhabit old buildings (Mech and Boitani 2006). Due to this high adaptive behaviour, and their opportunistic ecology, wolves can successfully share human dominated landscape. However, this close relation to human dominated landscapes can also originate wolf human persecution, especially when there is some conflict of interest between wolf and humans regarding resource use (e.g. cattle). This is particularly relevant in Portugal, a small country, highly impacted and fragmented by

human activities (Grilo *et al.* 2002; Feranec *et al.* 2016). Contrary to the European trend, wolf populations in Portugal have decreased during the last decades, occupying now only 20% of their original range (Pimenta *et al.* 2005). This was not only due to habitat destruction and fragmentation but mainly, due to human persecution (Grilo *et al.* 2002, 2004). Several reasons underpin this persecution being the most important wolf livestock depredation, leading to human retaliation and ultimately causing wolves mortality (Grilo *et al.* 2002, 2004). This means that wolf conservation is deeply linked to human tolerance, so for the success of wolf conservation, it is necessary to evaluate the human dimension of the conflict, since several authors agree that by understanding people's attitudes, perceptions and tolerance, conservation and management programs can be specifically adapted and successfully implemented (Kleiven *et al.* 2004; Bath *et al.* 2008; Lucherini and Merino 2008; Bruskotter *et al.* 2015; Dressel *et al.* 2015).

1.2. *Canis lupus signatus* in Portugal

The Iberian wolf (*Canis lupus signatus*), an endemic subspecies of the Iberian Peninsula, was first described by Cabrera (1907), is characterised by its smaller size, white upper lips, and darker marks on the tail and front legs. Although some authors questioned the differentiation from grey wolf, genetic studies have confirmed high level of genetic variability regarding other Eurasian wolves populations (Vila *et al.* 1999; Lucchini *et al.* 2004; Ramirez *et al.* 2006; Torres and Fonseca 2016; Pires *et al.* 2017). They were originally present throughout all Portuguese territory, however during the 20th century, while European carnivore populations expanded, the Portuguese lupine territory decreased by their 80% (Figure 1). This was a result of road network expansion, deforestation and increased forest fires, decrease of wild prey density and wolf livestock depredation, which lead to human persecution/retaliation, ultimately causing wolves mortality (Roque *et al.* 2005; Espirito-Santo 2007), factors that still impact current wolf distribution.

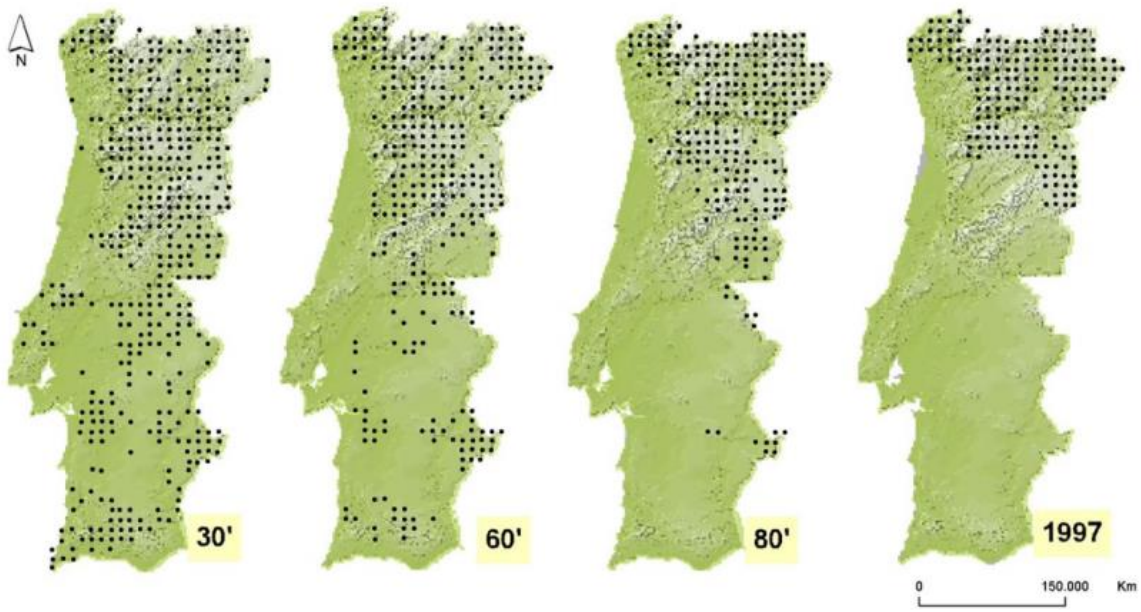


Figure 1. *Trends of wolf distribution in Portugal (Source: Álvares 2011).*

Due to the increased threat to wolf preservation in the country, in 1988 the Decree-Law nº 90/88, classified the Iberian wolf as a protected species (Alexandre *et al.* 2000), prohibiting its' hunting and capture, preventing destruction and degradation of its' habitat, as well as disturbance during the mating season. This law also established compensation rights, which are attributed when a confirmed event of wolf depredation to livestock occur. Wolves are also protected by the Bern Convention (Annex II), CITES and Habitats Directive (92/43/ CEE), and are listed in the Portuguese Red Data Book as an "Endangered" species, with 30% of their distribution in National Portuguese Protected Areas or areas of the Nature 2000 Network (Cabral *et al.* 2005; Torres and Fonseca 2016).

The Iberian population is estimated to be of 2.700 individual (LCIE 2019), but only 300 wolves remain in Portugal, according to the last census conducted in 2002-2003, (Pimenta *et al.* 2005), which confirmed the existence of 51 packs and 12 probable packs (Figure 2). They are divided in two smaller subpopulations, one more stable located north of Douro river, with connectivity to Spanish populations, and another more fragile and isolated population south of Douro river (Alexandre *et al.* 2000; Álvares 2004, 2011; Espirito-Santo 2007; Torres and Fonseca 2016).

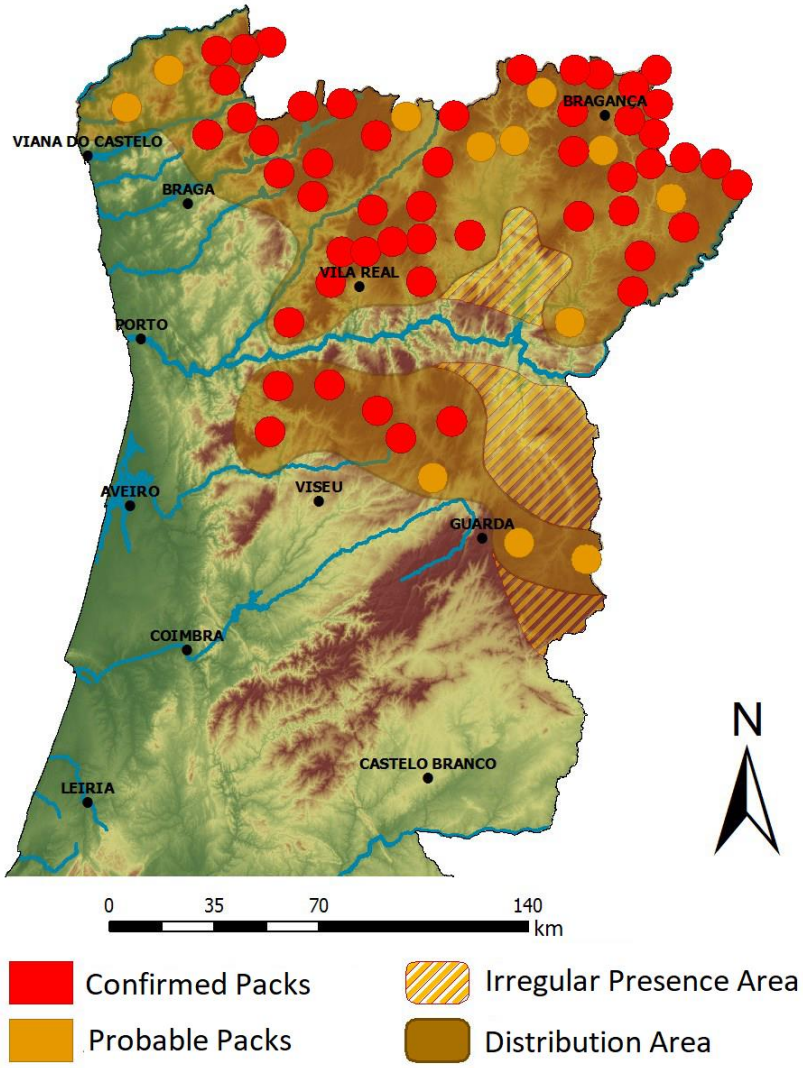


Figure 2. *Wolf Packs distribution in Portugal, confirmed and probable (Source: Pimenta et al. 2005)*

This southern subpopulation, with only 6 confirmed and 3 probable packs, is small, highly fragmented, isolated, with low genetic variability and instable reproduction, mainly due to their isolation from other Iberian populations (Grilo *et al.* 2002; Pimenta *et al.* 2005; Godinho *et al.* 2007). This subpopulation is composed by two nuclei, the Pisco pack and transborder nuclei, and the Arada/Trancoso nuclei. During the census of 2002-2003, it was estimated the existence of three probable packs in the first nuclei, Sabugal Jarmelo and Pisco pack (Pimenta *et al.* 2005; Torres and Fonseca 2016), and in 2012, the Almeida Pack was confirmed (Cadete *et al.* 2012; Torres and Fonseca 2016). The Arada/Trancoso nuclei

is composed of six confirmed packs (Cinfães, Montemuro, Leomil, Arada, Lapa and Trancoso packs) and three probable packs (Torres and Fonseca 2016).

1.3. Rationale behind this study - Wolf conflicts in Portugal

The wolf connection to European culture is ancient. Although wolf always had difficult relationship with shepherds, old civilizations used to admire them, incorporating wolves in mythology regarding European gods or connecting them to the creation of cities, such as Rome. This all changed with the expansion of the Roman Catholic Church, which adopted the vision of the wolf as deceiving, evil animal (Boitani 1995). During the Middle Age, wolves persecution intensified, largely due to campaigns against wolves incentivized by the Roman Church (Boitani 1995; Mech and Boitani 2006). Rural populations in Portugal are historically dependent on agriculture and livestock exploitation. Although conflict in Portugal is historic and deeply rooted, it is mainly motivated by livestock depredation. In northern Portugal, there are conflict reminders near villages with historic wolf presence, called "fojos". These were structures that involved two high stone walls that ended in a deep circular pit, and wolves were chased and directed by rural populations to the pit or by placing a live bait on the bottom of the pit, called the "goat fojo" (Álvares and Primavera 2004; Álvares 2011). Although no visible structures of conflict exist south of Douro river, conflict is deeply rooted in the area, mainly due to scarcity of wild prey (Espirito-Santo 2007; Torres *et al.* 2015). Torres et al. (2015) diet study showed that more than 90% of wolves' diet consisted of livestock, being the three main prey goat (> 50%), cow and sheep. This high dependency on livestock, surely exacerbates the existing conflict, resulting in direct persecution, since husbandry practice is the main source of income for many local farmers (Roque *et al.* 2005; Espirito-Santo 2007; Torres *et al.* 2015). With the passing of Decree-Law n.º 90/88, shepherds are entitled to compensation if their livestock is depredated by wolves (*Decreto-Lei nº 90/88* 1988). To apply for compensation, livestock owners must report attacks to the national nature conservation authority *Instituto da Conservação da Natureza e das Florestas (ICNF)*, which dispatches technicians to inspect the carcasses and infer if wolf depredation occurred and verify if the protection pre-

requisites required by law were being practiced (*Portaria 335/2017* 2017). According to Torres *et al.* (2015), these compensations are about € 1,000,000, yearly. It is a worldwide policy applied to mitigate damages dealt by protected carnivores aiming to reduce not only economic impact, but also improve tolerance towards wolf's presence (Milheiras and Hodge 2011). Nevertheless, the efficacy of this policy is not established yet, even decades after the implementation of compensatory policies. Some reports defend that attitudes have not improved due to such approach (Milheiras and Hodge 2011; Rigg *et al.* 2011; Marino *et al.* 2016). This may be due to information not getting across to livestock owners, like the case reported in Slovakia, where a vast number of livestock owners were not aware that compensations policies for depredation by wolf existed (Rigg *et al.* 2011). In the area, wolves are also viewed as threats to husbandry practices. By law, compensations payment must be made 30 days after ICNF acknowledges the rightful access to compensation, although this is seldom practiced (*Portaria 335/2017* 2017). Local shepherds state that compensation payments are often delayed, taking as long as 2 years, and are insufficient to cover economic losses. Currently, this is the only policy implemented, in Portugal, aiming to increase tolerance to wolves presence (Torres and Fonseca 2016).

Espirito-Santo (2007) conducted the first Portuguese study combining human dimension and wolf management on the south of Douro river. It concluded that attitudes were mainly neutral, tending to positive. General public had the most contrasting attitudes, resulting in the division of this stakeholder in two, the ones with a positive attitude and those with a negative. The livestock owners had the lowest attitude score, and the highest fear. Lastly, general knowledge was low, being the hunter's stakeholder group the ones with the highest knowledge score of the three groups. This author aim was not only to understand attitudes and knowledge towards wolves, but also to increase stakeholders' participation in wolf conservation. Twelve years have passed, and wolf conflict remains, but have attitudes towards wolves changed?

Because understating human attitudes towards wolves is utterly important for increasing human tolerance but also wolves conservation and survival, this study aimed to i) Identify the individual sociodemographic (e.g. age, gender, fear, knowledge) drivers

shaping the attitudes of the different stakeholders (cattle breeders, hunters and general public) towards de wolf; ii) Identify the individual sociodemographic (e.g. age, gender) drivers shaping the fear level of the different stakeholders (cattle breeders, hunters and general public) towards de wolf; iii) Identify the individual sociodemographic (e.g. age, gender) drivers shaping the knowledge level of the different stakeholders (cattle breeders, hunters and general public) towards de wolf; iv) provide information regarding the main variables influencing conflict with the objective to help create tailored conservational measures that result in higher success rate.

Based on previous studies (Espirito-Santo 2007; Espirito-Santo *et al.* 2016; Espirito-Santo and Petrucci-Fonseca 2017) and the high levels of depredation in the area, I hypothesize that: (I) Attitudes tend to be neutral, except for livestock owners that present more negative attitudes (due to livestock losses); (II) Knowledge regarding wolf is low, being the general public the lesser knowledgeable; (III) Fear is correlated with negative attitudes and lower knowledge (since they have less direct experience with the species, and previous studies in the area have showed this tendency (Espirito-Santo 2007)); (IV) Knowledge and attitude do not show a clear relationship (based on previous studies conducted in the area (Espirito-Santo 2007)).

Material and Methods

Study Area

This study will only focus in central Portugal, more specifically on the eastern part of wolf distribution south of Douro River, where three of the six confirmed and established packs, Cinfães, Montemuro and Arada packs, are present along the mountain ranges of Arada, Freita and Montemuro. These locations are protected under the Natura 2000 Network, "Serra Montemuro" (PTCON0025) and "Serra Freita-Arada" (PTCON0047) with an area of 750 km^2 (Figure 3), corresponding to approximately 30 to 50% of Wolf Population habitat south of Douro River. These packs are characterized by low population densities with undetected reproduction during the 2002-2003 census. Their fragility has increased due to habitat and population fragmentation, low genetic flow, forest fires, human persecution and lack of wild prey (Alexandre *et al.* 2000; Roque *et al.* 2005; Torres *et al.* 2013).

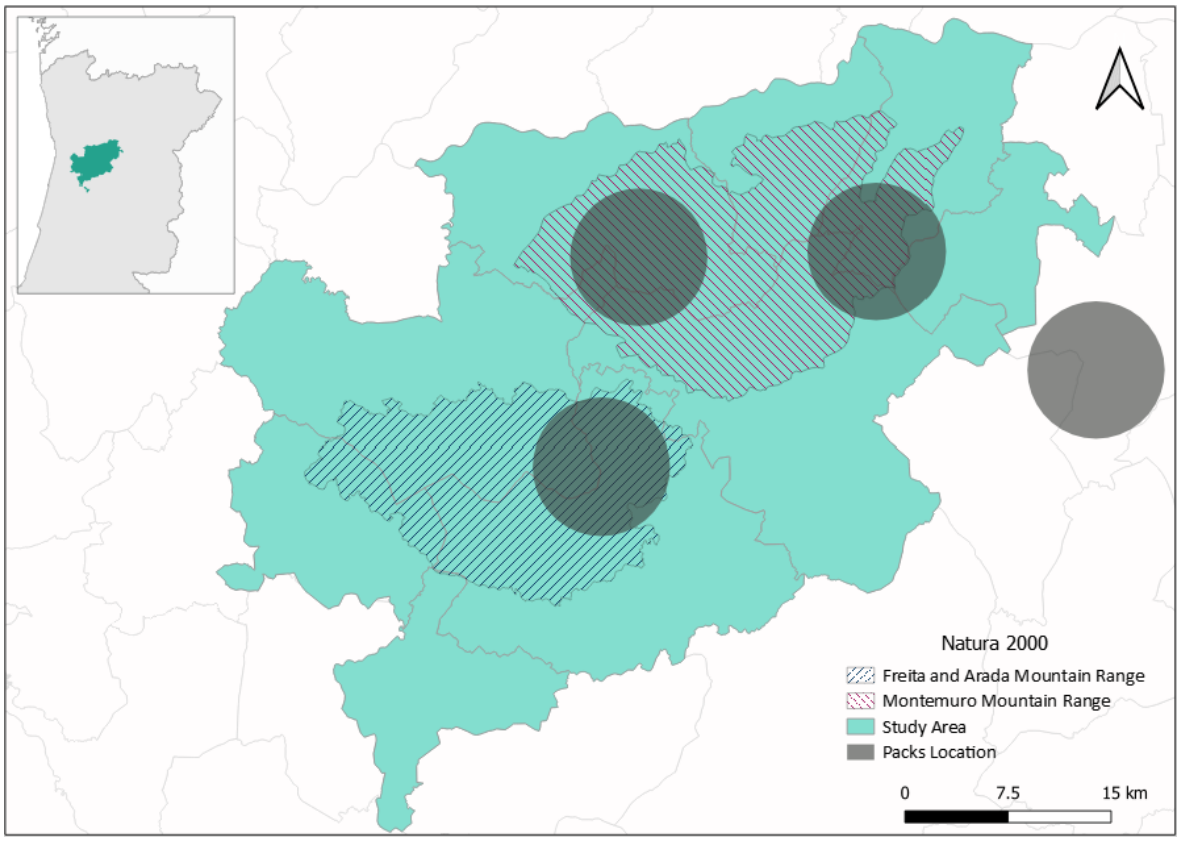


Figure 3 *Study Area (blue), Natura 2000 Network sites (striped) and wolf packs location.*

The main economic activity in the rural and suburban areas of the study area is agriculture, where a high number of pastures and agriculture fields can be seen throughout the landscape (Cruz *et al.* 2014; Torres *et al.,* 2015). Furthermore, livestock production presents a similar pattern, with ruminants grazing on uncultivated lands. Husbandry practice used is mainly free ranging husbandry, where livestock, during daytime, tend to roam alone through the mountains, while smaller ruminants tend to be accompanied by a shepherd and/or sheepdog. During night-time, livestock is enclosed in barns (Torres, et al. 2015).

Although relatively close to one another, Arada-Freita and Montemuro mountain ranges are two distinct protected areas, each with peculiar characteristic, diverging not only in size, but also in vegetation and land usage.

Arada-Freita

The climate is mainly Mediterranean but with high oceanic influence, with high levels of precipitation (average annual precipitation >2000 mm) mostly during the autumn and winter months (Almeida 2009), creating the ideal habitat for rare and diverse species. The maximum altitude is 1085m on Freita mountain range and 1071m on Arada. Over an area of 287km^2 the mountains are dominated by a scenery of steep slopes, and some plateau, where the rural landscape dominates. Land usage is characterized by agricultural areas (10%) and forest (66%), where urban areas account for only 10% of the territory. Regarding flora diversity, while shrubs are vastly present (14% of land cover) (e.g. *Ulex minor* and *Erica tetralix*), there are also English oak (*Quercus robur*), the Pyrenean oak (*Quercus pyrenaic)*, European holly (*Ilex aquifolium)* and Black alder (*Alnus glutinosa)*. The most important is the existence of two flora Iberian endemism *Narcissus cyclamineus* and *Woodwardia radicans*.

Montemuro

Similar to Serra Arada-Freita, the climate is mainly Mediterranean, with an average annual precipitation >1500mm. This is one of the ten areas with highest precipitation levels in Portugal (Almeida 2009). With an area 388km^2, the landscape is dominated by the Massif Mountain where the highest altitude is 1381m. This area is composed by scrublands (38%), agricultural areas (30%), forest (26%), while the urban areas account only for 6% of the territory. In terms of flora diversity, moorlands are highly represented by *Erica ciliaris* and *E. tetralix*, while forest area is composed mainly by Black alder (*Alnus glutinosa)*, Ash (*Fraxinus excelsior)* and the Pyrenean oak (*Quercus pyrenaica)*. Habitats are highly conserved, presenting great levels of biologic diversity. The most concerning threats for wildlife conservation are forest fires (between 1999 and 2003, 55% of the area burned) and construction of infrastructures and communication network (e.g. A24 construction resulted in fragmentation of wolf habitat).

1.4. Stakeholder groups

For the purpose of this study, attitudes, as well as fear and knowledge levels, of three local stakeholder groups were considered: general public, hunters and livestock owners. This stakeholder groups were chosen because they are directly affected when wolfs' conservational measurements and policies are defined and implemented, but also due to their proximity to areas used by wolves (Sterling *et al.* 2017). Since each stakeholder group has different type and scales of interactions with wolves, due to their specificity in landscape use, it is necessary to understand how wolves can impact each groups' attitude, knowledge and fear levels, as well as the drivers shaping it patterns.

General Public

Two districts cross the study area, Aveiro, englobing only two municipalities Arouca and Vale de Cambra, and Viseu, that includes seven municipalities, Castro Daire, São Pedro do Sul, Oliveira de Frades, Cinfães, Lamego, Resende and Tarouca. Higher populational densities are located on two municipalities, Lamego and Arouca, followed by the towns Resende and Macieira de Cambra. The remaining human settlements are smaller towns and remote parishes, scattered through rough valleys with population densities lower than 150 resident/km^2 (Figure 4), (INE 2019a). When compared to 2010 population data, population aging index (ratio of the number of elderly persons (>65 years old) to the number of young persons (0-14 years old) in these municipalities is higher, with tendency to increase, ranging from 152% in Arouca to 257% in São Pedro do Sul, meaning that the population is aging (PORDATA 2019). For the purpose of this study, general public was considered all the inhabitants that reside in the area who have no livestock or are hunters.

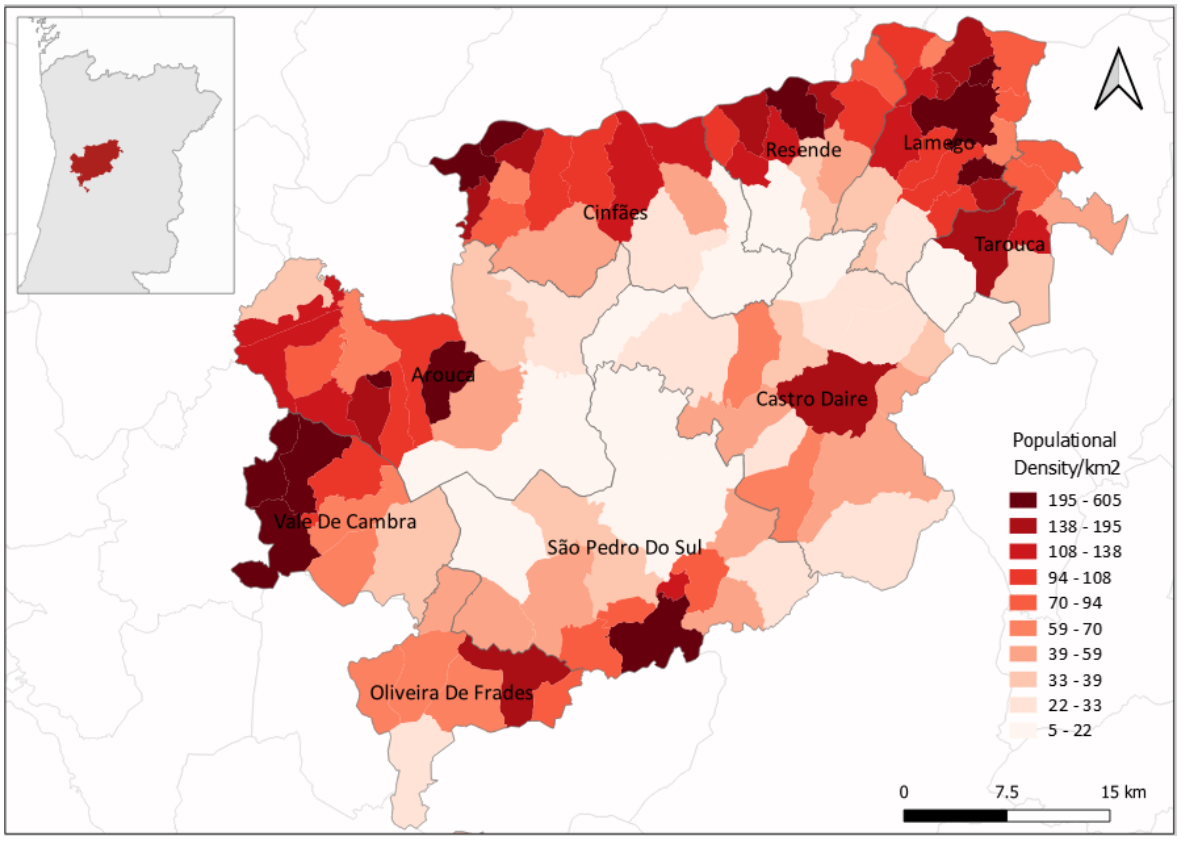


Figure 4 *Populational density in the study area, by parish.*

Hunters

Hunting is a tradition in the Portuguese culture, especially in rural areas. Portuguese hunters population is aging, being the average hunter older than 50 years old (Santos *et al.* 2015), and the demand for this activity has been decreasing. According to the 2015 ICNF report, from the 2000/2001 to the 2014/2015 hunting season, the emission of hunting permits decreased by 50,3%, at a national level (Santos *et al.* 2015). The main reasons appointed for this decline were the aging of hunters' population and lack of recruitment of younger hunters. Nevertheless, while the number of hunters decrease, hunting grounds per licence are increasing. In the year 2000 the hunting grounds per licence was around 12 hectares, having increased to approximately 63 hectares in 2015 (Santos *et al.* 2015).

According to the ICNF, the study areas hunting grounds are mainly Associative (managed by private hunting associations) and Municipal (managed by the municipality), where the hunters are typically from neighbouring areas. Although wolf hunting is illegal, due to the legal protection of the species, recreational hunting still impacts their survival, either be it by poaching, or the reduction numbers of their natural prey (Espirito-Santo 2007).

Livestock Owners

Studies have showed that livestock owners are the group that experience more direct negative interactions with wolves, mainly due to livestock predation (Vos 2000; Kaartinen *et al.* 2009; Marino *et al.* 2016). They have a high risk levels of suffering from livestock depredation (Passinha 2018), especially those that produce goat meat, which represents more than 50% of wolves diet (Torres *et al.* 2015). Although domestic animals dominance in wolves diet composition has decreased slightly, while an increase in wild ungulates was registered since 1988 (Passinha 2018), livestock production has remain stable in the last 10 years, being an important source of income in the study area (INE 2019b). Now-a-days, chicken farms are the main livestock activity in the area, followed by sheep, goat and cow breeding. Nevertheless, recent studies have not reported chicken as a part of locals wolves

diet (Torres *et al.* 2015), even though they had been previously reported in the study area wolves diet (Passinha 2018).

1.5. Data Sampling

For the purpose of this study, a questionnaire, based on several previous studies about conflict management of large carnivores, was created in order to study the attitudes and perceptions of local human population towards wolves (Roque *et al.* 2005; Espirito-Santo 2007; Marchini and Macdonald 2012).

The questionnaire (Annex) was structured in four distinct parts, containing a total of 38 questions:

I. Individual sociodemographic data (9 Questions);
II. Personal experiences with wolves (9 Questions);
III. Personal opinions (15 Questions);
IV. Influence of the media (5 Questions);

From March 2018 to April 2019 data collection was done anonymously, and randomly, either using google forms to collect information about the public, or left at villages key points (coffee shops, associations, etc.) for the locals to answer. Surveys were also performed as interviews to people encountered on the street or rural dirt roads along the study area. This last method showed to be the least efficient for two reasons: i) being very time consuming and, ii) in majority of the cases, lead to response bias (people were reluctant to answer, and were constantly trying to see my reaction to their answers).

1.6. Data Analysis

Between March 2018 and April 2019, a total of 314 questionnaires were collected, and before we begin the statistical analysis, data had to be prepared and transformed. First, the questionnaires were filtrating by county, leading to the removal of 57 that had been submitted by residents outside of the study area. From the remaining, any unanswered questions required for the analysis (Figure 5) lead to its exclusion (35 excluded). Only 222 questionnaires from the study area (Figure 6) were used in the analytical procedure

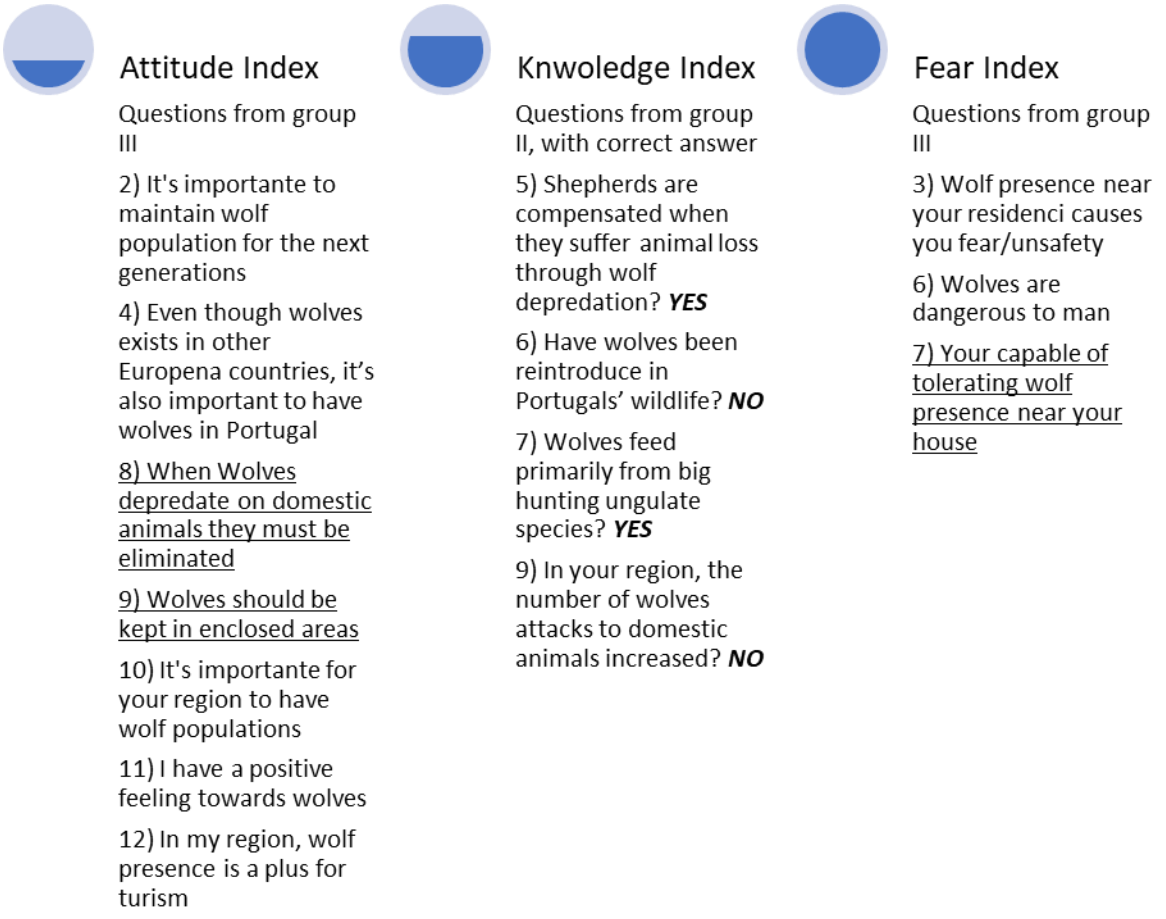


Figure 5. *Questions used for Data analyses of the Attitude Index, Knowledge Index and Fear Index. Likert scale was reversed for the underlined questions so that 1 corresponded to the least positive attitude, or least fearful, and 5, most positive, or highest level of fear.*

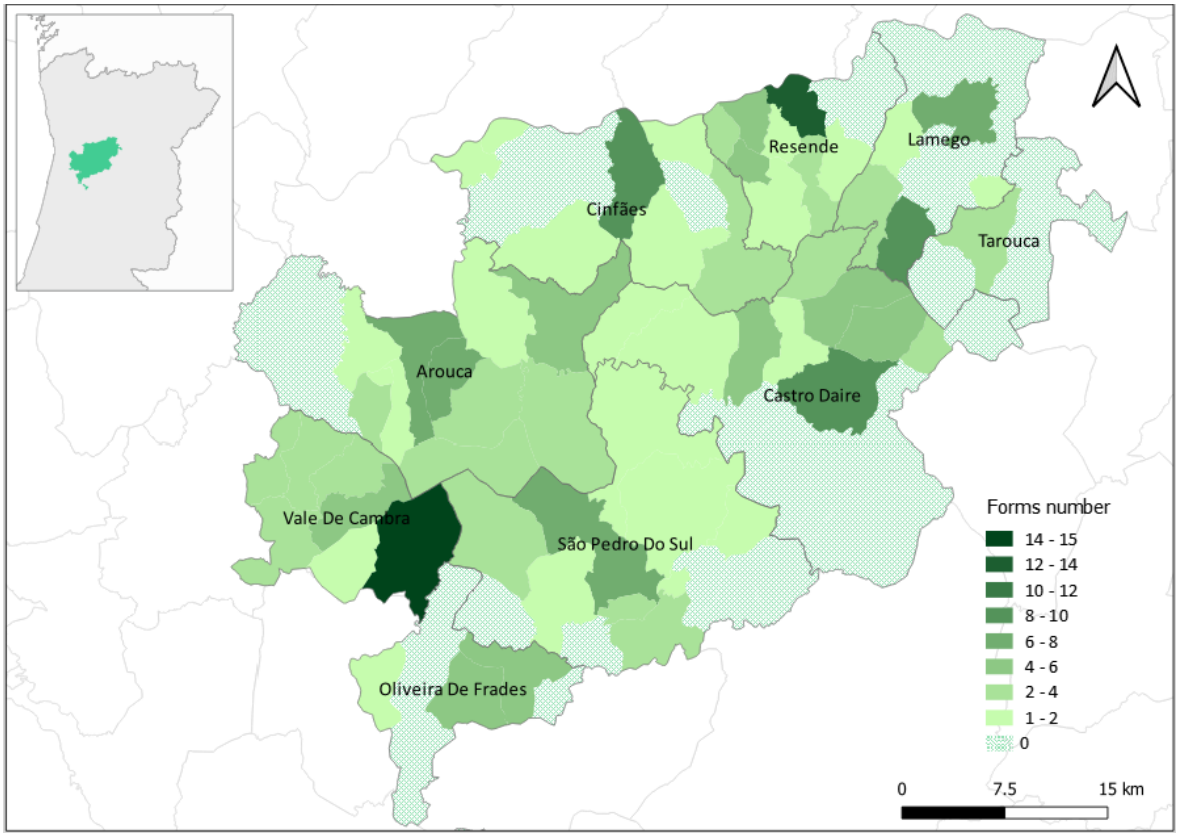


Figure 6. *Questionnaire distribution by parish.*

Data analysis began by characterizing participants using the sociodemographic questions, and the computation of three indexes (Figure 7). Due to the way some questions were constructed, the used scale had to be reversed so that 1 corresponded to the least positive attitude, or least fearful, and 5, most positive, or highest level of fear (underlined questions on figure 5).

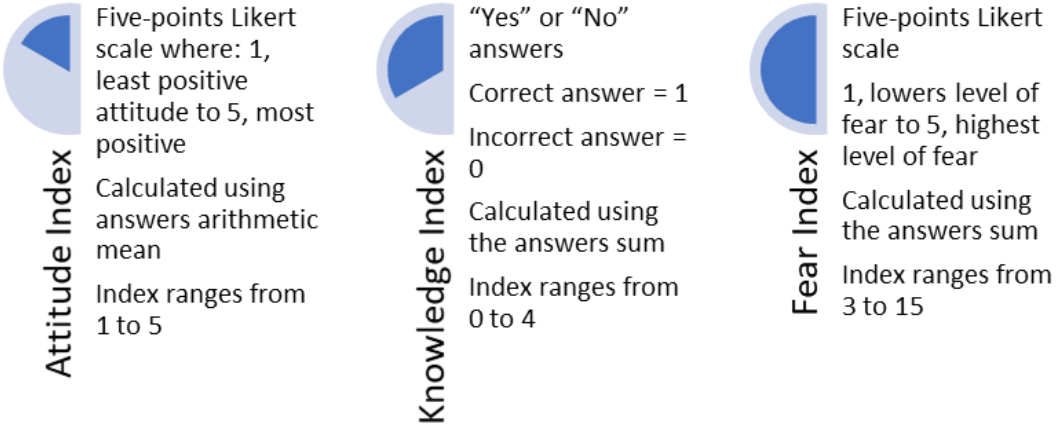


Figure 7. *Index resume, indicating used scale, how the index was calculated and index range for the three Indexes, Attitude, Knowledge and Fear.*

We also tried to assess the influence of myths and stories can influence respondents' fear towards the wolf. Thus, we hypothesised that every participant that answered positively to the questions "*III-3) Wolf presence near your residence causes you fear/unsafety*", "*III-5) Do myths/Stories influence your opinion towards wolves*", might be expressing fear based on pre-assumptions. All analyses were performed on Microsoft Excel for Office 365 MSO software.

1.6.1. **Stakeholder Group Comparative Analysis**

For the three datasets (i.e. general public, hunters and livestock owners) we first tested the normal distribution of the data by using the Shapiro-Wilk test, which showed that our data did not followed a normal distribution (Table 1). As our data showed a non-parametric character, we used the Kruskal-Wallis H test, using a 0,5-significance level, to test for differences between stakeholder group indexes. To test for possible correlations between Indexes, a Spearman's rank correlation coefficient was computed. These analyses were performed using Rstudio (Version 1.1.456) and R software's (RStudio Team 2015; R Core Team 2018).

Table 1. *Results of the Shapiro-Wilk test.*

	Attitude Index	Knowledge Index	Fear Index
W	0.956	0.820	0.969
p-value	<0.001	<0.001	<0.001

Attitude and Fear Influences

To test what driver might be determining the variability in *attitudes* and *fear indexes* within the three stakeholder's groups, we used a Generalized Linear Mixed Model, based on logistic regression (Zuur *et al.* 2009). These models were performed for each stakeholders group, separately. The variables *Attitude Index* and *Fear Index*, were used as dependent variables, while those associated to demographic data (e.g. age, gender and scholarship level) as well the answer to the question *"Do you know of any wolf attack to domestic animals?"*, were treated as independent candidate variables in the modelling procedure (Table 2). For the data analysis of the cattle owner group, the answer to the question *"Do you know of any wolf attack to domestic animals?"* was removed from the independent variables group (in order to analyse if livestock predation by wolf influences shepherds attitudes, instead of predation knowledge), and two other questions were added *"Do you have shepherd dog?"* and *"Have you suffered loss of domestic animals by wolf depredation?"* (Category * and **; Table 2).

Table 2. *Variables used in the Attitude and Fear Models; (*Variables only used for shepheards; **Variable excluded from the Livestock Owners Analyses; ***Variable only used in the Attitude Model).*

Variables		***Varible R Code***	***Variable Description (Coding categories)***
Age of the participant Younger - 15 years old; Older - 88 years old		*AGE*	(1) 15-30 (2) 31-45 (3) 46-60 (4) >60
Gender of the participant		*GENDER*	(1) Male (2) Female
School level of the participant		*SCHOOL*	(1) 1st Cycle (2) 2nd Cycle (3) 3rd Cycle (4) Secondary Education (5) Higher Education
Residents Number of the Participants Parish Smallest - 203 Residents; Biggest - 12.214 Residents		*POPULATION_SIZE*	(0) <1000 (1) >1000
Shepherds/guard Dogs*	I *"Do you have shepherd dog?"*	*DOGS*	(0) No (1) Yes
Livestock Loss*	II-3 *"Have you suffered loss of domestic animals by wolf*	*LOSS*	(0) No (1) Yes
Knowledge of wolf atacks**	II-2 *"Do you know of any wolf attack to domestic animals?"*	*ATACKS*	(0) No (1) Yes
Participant Fear Index value***		*ID_FEAR*	Values Ranging from 3 to 15

Given the nested character from the index data, a random factor was introduced, the participants ID. For this reason and to better study variables influence on attitude and fear from each stakeholder groups, data was modelled using the generalized linear mixed model (GLMM; Zuur *et al.* 2009)

Since this dataset is ordinal and non-independent, it was used the Cumulative Link Mixed Models (CLMM) for ordinal logistic regression to create the models using the R (R Core Team 2018) 'ordinal' package (Christensen 2019). The function 'clmm' (Christensen 2019) was used with the connection function 'logit' and a symmetric threshold (i.e. the distance from the scale extremes is symmetric to its centre) to create the models for each stakeholder group in order to assess variables influence on fear and attitude.

For each dataset, models corresponding to all possible combination of the candidate variables were created using the package 'MuMin' (Bartoń 2019), and the 'dredge' function. The selection of the best model for each stakeholder and indexes datasets was done based on the Akaike Information Criterion corrected for small samples (AICc; Burnham and Anderson 2002). The models with a difference between their AICc value and the smallest AICc value <2 (i.e. ΔAICc<2), were considered the best models (Burnham and Anderson 2002). Those were, therefore, the ones containing the most influential variables in explaining the detected patterns. If more than one model presented a ΔAICc<2, we applied a model averaging procedure, using the function 'model.avg' of the R package 'MuMin' (Bartoń 2019) to estimate the average coefficients of the variables included in the best models, as well as the 95% confident intervals (95%CI). For each created model we also estimated the Akaike weight (w), that represents the probability of that model being the best model (Burnham and Anderson 2002). Those variables whose 95% confidence interval of their coefficient did not include 0, were considered the most influential on the dependent variable, since were the one for which we could infer their direction of their influence, i.e. positive or negative.

Sources of Information

To better understand the knowledge and attitude patterns towards wolves we have to find where people obtain their information. With that in mind, we compiled all the information mentioned by participants in question “IV-5) What are your information sources about wolves” and created a treemap using Microsoft Excel for Office 365 MSO software.

Results

2.1. Demographic characterization of participants

In total, 222 questionnaires were used for data analysis, the majority answered by male respondents (142 individuals), and with superior education, completed or not (108 individuals). Most inquired person also inhabited areas with more than 1000 habitants and were younger than 45 years old (159 individuals) (Table 3).

Figure 8A shows the gender representativeness in each of the stakeholders' groups. The sample include more males than females, and among each group, the general public had the highest number of females, then livestock owners and lastly the hunters' group, which only included 2 females.

The general public and livestock owners' group samples presented a similar age distribution, where most respondents comprised the 31-45 age group, followed by the 15-30 age group (Figure 8B). Regarding the hunters, most respondents were older than 60 years old, although the 31-45 age group was also well represented in our data sample.

In terms of the scholarship level, in all stakeholder's dataset the sample included more respondents with high school or high education level (Figure 8C). However, the general public data showed the highest number of sampled individuals with high education, completed or not. In the hunters' group, most participants had conducted high school (Figure 8C). The livestock owners' group showed a balanced sample between the two higher level of educations: 29 respondents affirmed to have high school education, and 29 stated that they frequented a degree of higher education (completed or not) (Figure 8C).

Regarding population size by location, the general public respondents inhabit areas with more than 1000 habitants, while in the hunters' group inhabited areas with less than 1000 habitants. In the case of livestock owners, no pattern in distribution was found.

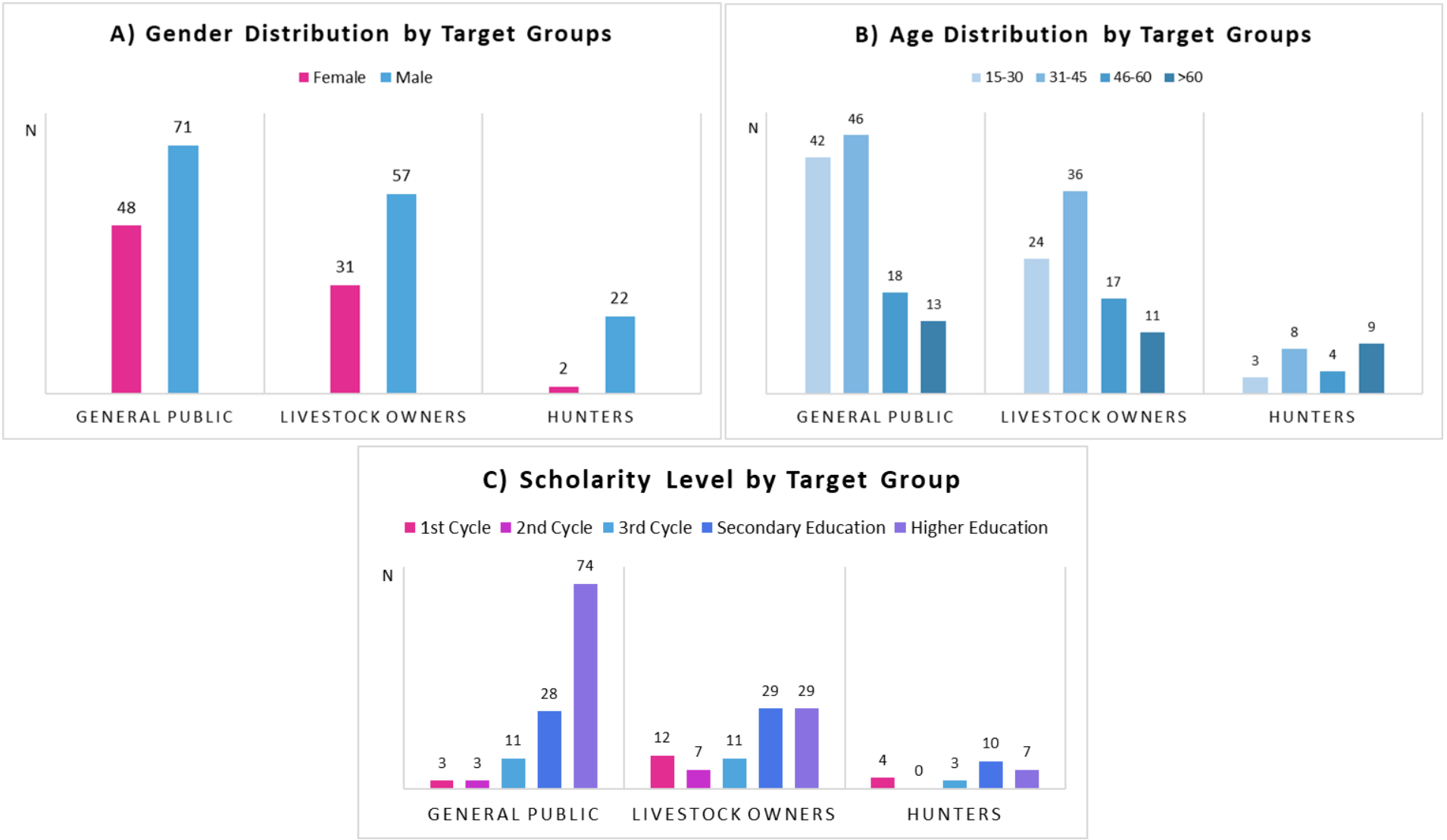
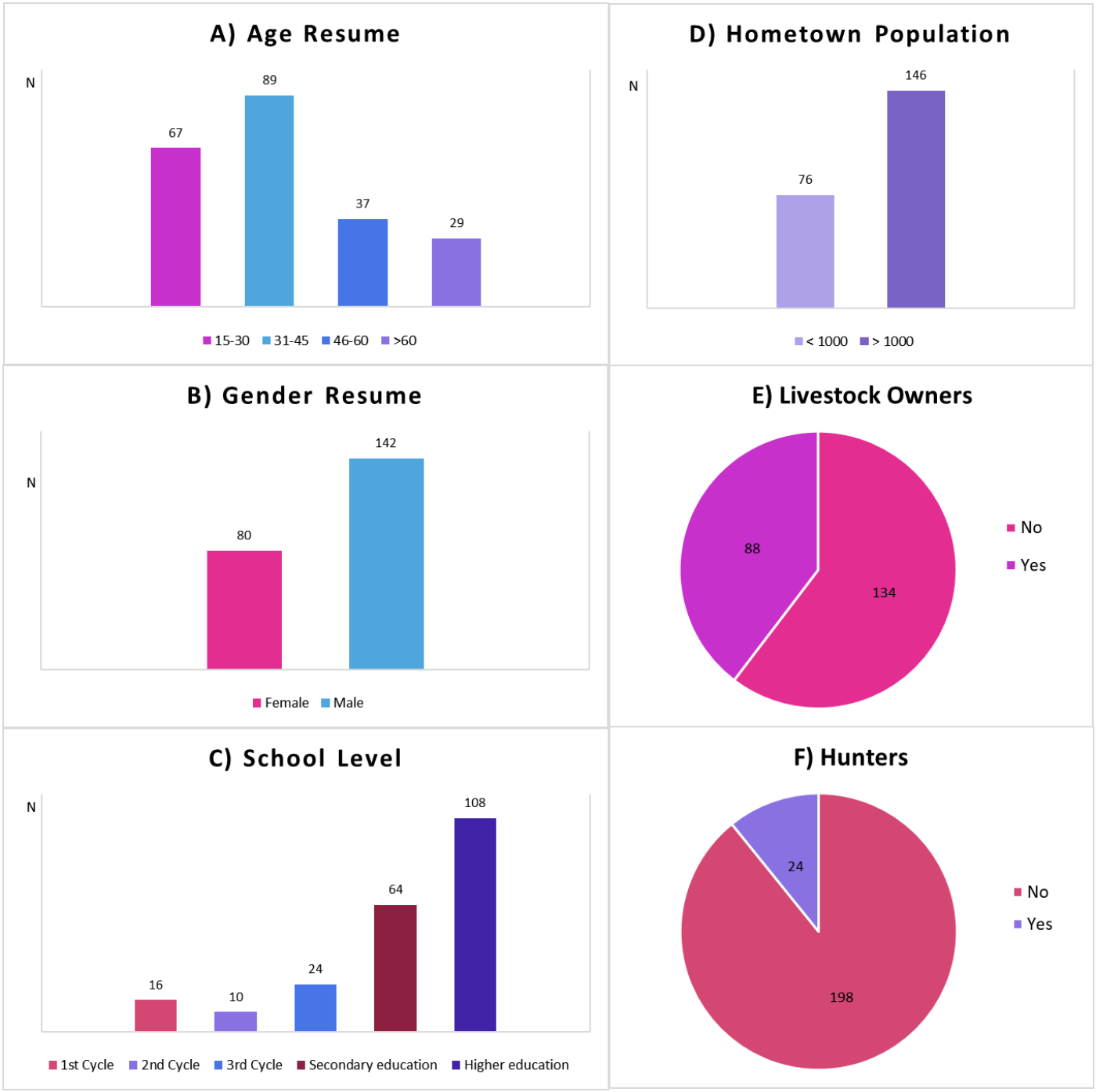


Figure 8. ***A)*** *Number of individuals (N) of the three stakeholder groups per gender category;* ***B)*** *Number of individuals (N) of the three stakeholder groups per age class;* ***C)*** *Number of individuals (N) of the three stakeholder groups per category of education degree.*

In short, average questionnaire respondent was male (60,16%), with ages comprised between 31-41 years old (36,33%), and with a high education degree, or having frequented a higher education institution (44,92% of respondents) (Figure 9).

Figure 9. *Socio-demographic summary of the participants in this study.* ***A)*** *Number of individuals (N) inquired per gender category;* ***B)*** *Number of individuals (N) inquired per gender category;* ***C)*** *Number of individuals (N) inquired per School Level;* ***D)*** *Number of individuals (N) inquired per hometown population;* ***E)*** *Number of individuals that are livestock owners;* ***F)*** *Number of individuals that are hunters.*



2.2. Fear Index

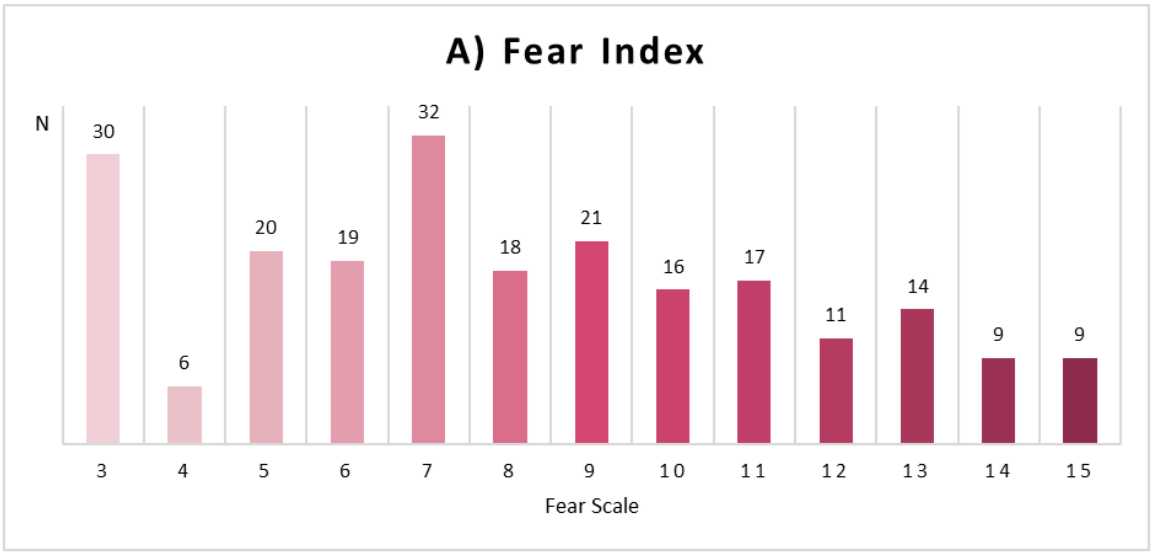
The *Fear index* ranged from 3, which represents no fear, to 15, the highest level of fear. The average overall *fear index* was 8.140, highlighting that most respondents do not have high fear levels (Figure 10A). However, the participants majority displayed a neutral, mode value 7, (Category 7; Figure 10A), to low levels of fear (Category 3; Figure 10A) towards the wolf.

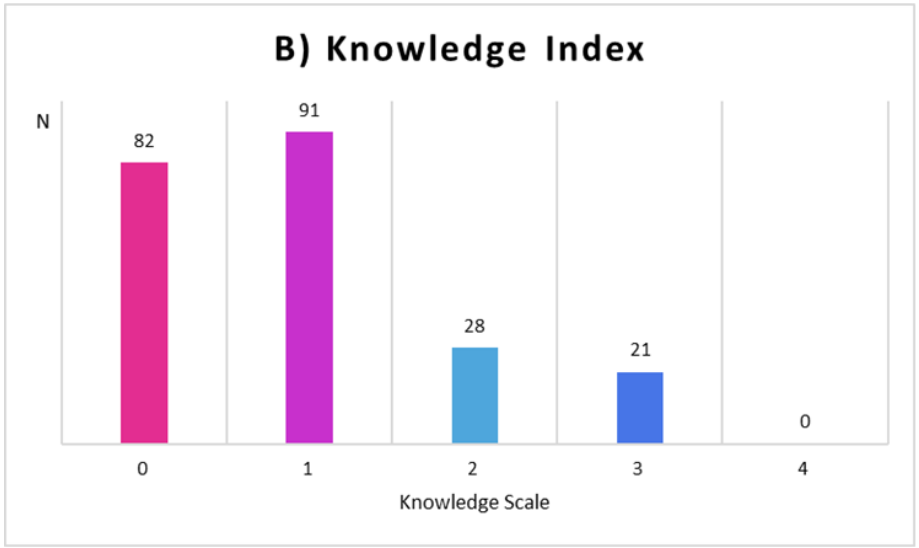
2.3. Knowledge Index

Knowledge index ranges from 0, representing no knowledge, to 4, the highest level of knowledge. These results showed that the average overall index result is very low 0.946, highlighting that respondents' knowledge about wolves' ecology and legislation is very low. No respondent showed a knowledge level higher than to 3 (Category 4; Figure 10B), having the majority of the participants shown a knowledge lower than 2, mode value 1, (Categories 0 and 1; Figure 10B).

2.4. Attitude Index

Attitude Index ranges from the most negative attitude, represented by 1, to the most positive attitude, represented by 5. When analysing all groups together, attitude score reached an average value of 3.557, indicating that, overall, the attitude is neutral, tending to positive (figure 10C). However, the majority of the participants revealed a positive attitude towards the wolf (Category 3-5; Figure 10C).





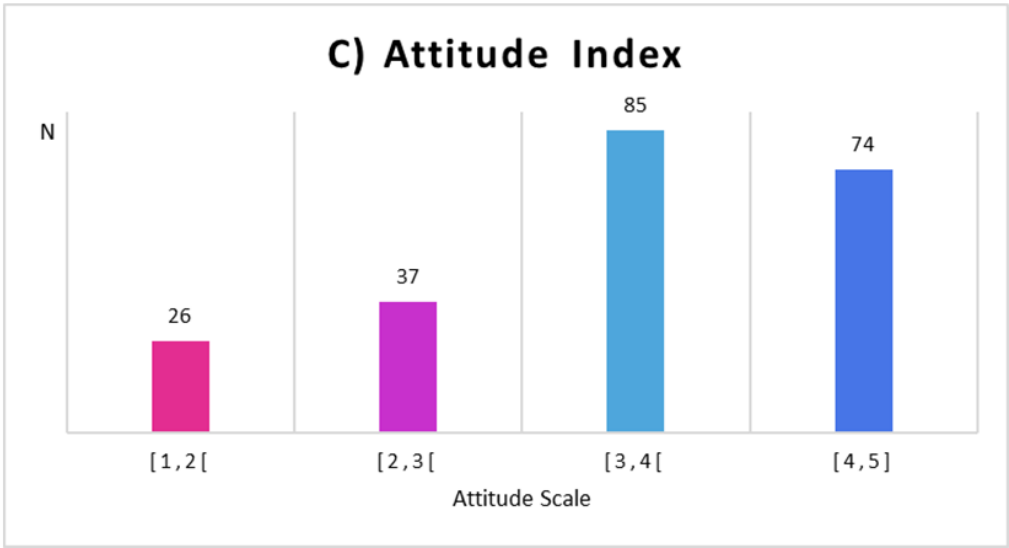


Figure 10. ***A)*** *Number of individuals (N) included in each Fear Index category mean;* ***B)*** *Number of individuals (N) included in each Knowledge Index category;* ***C)*** *Number of individuals (N) included in each Attitude index category.*

2.5. Index comparison between stakeholder group

Fear Index

Our results show that the different stakeholder groups do not present significant difference in fear levels towards wolves (H = 0.11224, df = 2, p-value = 0.9454). Overall, fear levels were considered neutral tending to positive, being group means 8.24 for livestock owners, 8.21 for hunters' group and 8.14 for the general public (Figure 11).

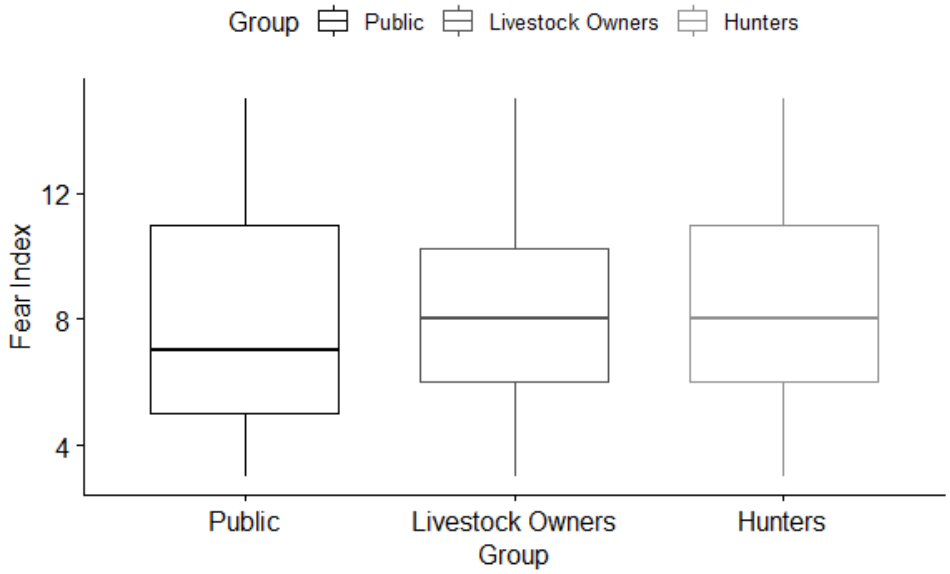


Figure 11. *Estimated Fear Index for each stakeholder group. Data is presented as median (quartile 2) and first (Q1) and third (Q3) Quartiles.*

Knowledge Index

The estimated wolf's *Knowledge Index* showed no significant differences between stakeholder groups (H = 0.722, df = 2, p-value = 0.697). All the groups present a knowledge level lower than 1.5 (Figure 12).

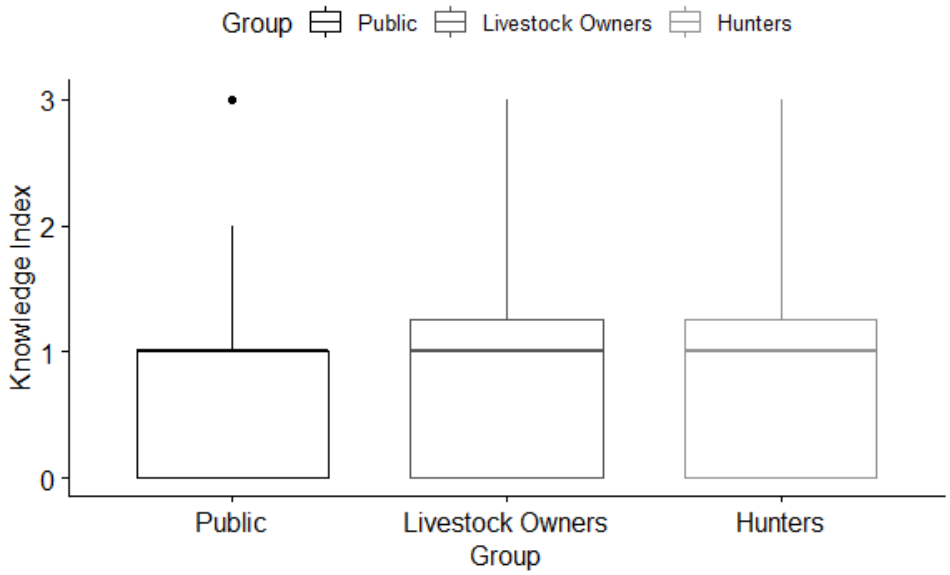


Figure 12. *Estimated Knowledge Index for each stakeholder group. Data is presented as median (quartile 2) and first (Q1) and third (Q3) Quartiles.*

Attitude Index

These results show that different stakeholder groups have significant different attitudes towards wolves (H = 9.078, df = 2, p-value = 0.011), with the general public showing a more positive attitude, with a mean of 3.74 (Figure 13).

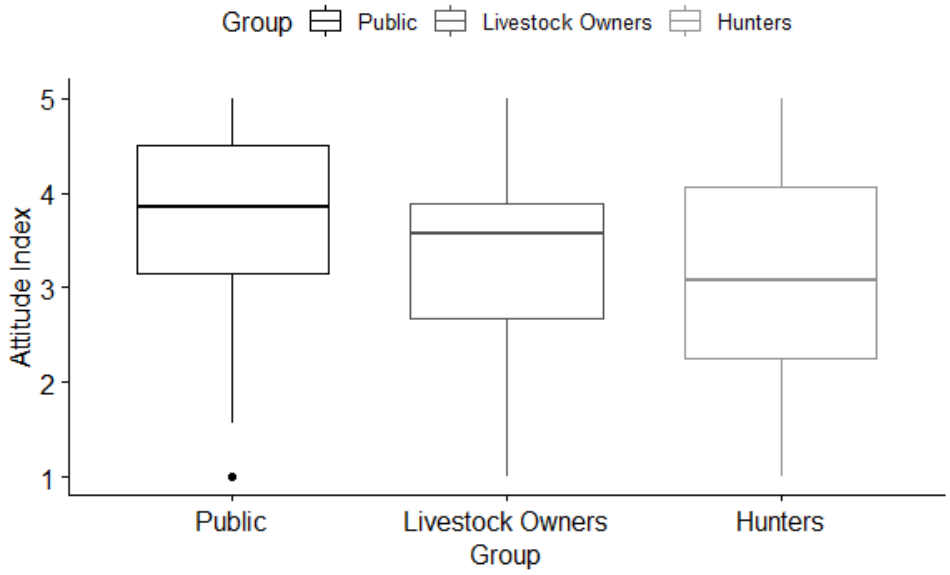


Figure 13. *Estimated Attitude Index for each stakeholder group. Data is presented as median (quartile 2) and first (Q1) and third (Q3) Quartiles.*

2.6. Index correlation

As mentioned, we tested the significance of the correlations between indexes by using the Spearman's rank correlation coefficient. In this analysis we only compared the overall indexes and no stakeholder group dataset subdivision was performed, since the main objective was to evaluate a possible influence each Indexes may have in each other. In the case of the *Knowledge* and *Fear Index*, our results showed a significant negative correlation (ρ = -0.296; p = <0.001), i.e. individuals with higher levels of knowledge regarding wolves' ecology and legislation tended to have less fear. *Attitude* and *Fear Index* showed a similar pattern, with a significant negative correlation (ρ = -0.724; p = <0.001), with individuals with higher levels of fear presenting a more negative attitude towards wolves. Inversely, *Attitude* and *Knowledge* Indexes showed a significant positive correlation (ρ = 0.244; p = <0.001). Individuals with higher knowledge showed a more positive attitude towards wolves.

2.7. Factors that Influence Attitude index by Stakeholder Group

General Public

For the general public, a total of 128 models (Annex II) were produced, but only three were considered best model (i.e. ΔAICc < 2; Table 3).

Table 3. *Three Best Models (ΔAICc < 2) for explaining the variability in the Attitude index for the General Public. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight).*

Model Number	*Knowledge of Attack*	*Gender*	*Population Size*	*Fear Index*	*AICc*	*ΔAICc*	*Akaike Weight*
49			+	-0.473	1966.1	0	0.269
53		+	+	-0.465	1967.1	1.03	0.161
50	+		+	-0.467	1967.5	1.41	0.133

"+" indicated that the categorical variable is included in the model

The best model described in Table 4 used the variables *Population Size*, *Fear Index*, *Gender*, and *Attack knowledge*. These seem to be the most influential variables in explaining the variation in attitude towards the wolf by the general public. The average model produced using these three models shows that people inhabiting areas with >1000 habitants have higher probability of showing positive attitudes towards wolves (Table 4). It also shows that as the *Fear index* value increases the probability for someone to display more negatives attitudes towards wolves also increases (Table 4). Only these two variables presented a coefficient 95% confidence interval that do not include the zero, and for that reason it is possible to assess accurately if the influence of the variables is positive or negative (Table 4). The same reasoning is applied to the variables *Gender* and *Attack knowledge*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear).

Table 4. *List of variables included in the average model, produced to assess the diver of General Public Attitudes variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>|z|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero)*.*

					95% Confidence interval	
Independent variables	**β**	**Std. Error**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
POPULATION_SIZE (1)	**0.858**	**0.288**	**2.983**	**0.003**	**0.294**	**1.422**
ID_FEAR	**-0.469**	**0.039**	**12.052**	**< 0.001**	**-0.546**	**-0.393**
GENDER (2)	-0.256	0.256	1.001	0.317	-0.757	0.245
ATACKS(1)	-0.206	0.260	0.790	0.429	-0.715	0.304

**Where: POPULATION_SIZE (1) = >1000 habitants; ID_FEAR = Fear Index; GENDER (2) = Female; ATTACKS (1) = Has knowledge of wolf predation to livestock.*

Livestock Owners

For this group, a total of 256 models (Annex III) were produced, but only five were considered the best model (i.e. ΔAICc < 2; Table 5).

Table 5. *Five Best Models (ΔAICc < 2) for explaining the variability in the Attitude index for the Livestock Owners. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight).*

Model Number	***Dogs***	***Gender***	***Animal Loss***	***Population Size***	***Fear Index***	***Age***	***AICc***	***ΔAICc***	***Akaike Weight***
194	+				-0.466	+	1606.8	0	0.159
193					-0.470	+	1607.7	0.93	0.100
226	+			+	-0.456	+	1607.8	1.03	0.095
210	+		+		-0.461	+	1608.7	1.97	0.060
198	+	+			-0.464	+	1608.8	1.99	0.059

"+" indicated that the categorical variable is included in the model

The best model described in Table 6 include the variables *Dogs*, *Fear Index*, *Age, Animal loss, Population size* and *Gender.* These seem to be the most influential variables in explaining the variation in attitude towards the wolf by the livestock owners. The average model produced using these five models showed that people older people (> 60 years old), as well as people with higher *Fear Index* value, have higher probability to display negative attitudes towards wolves (Table 6). Only these two variables presented a coefficient 95% confidence interval that do not include the zero (Table 6). The same reasoning is applied to the variables *Dogs*, *Animal loss*, *Population size* and *Gender*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear)

Table 6. *List of variables included in the average model, produced to assess the diver of Livestock Owners Attitudes variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>|z|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero)**

					95% Confidence interval	
Independent variables	**β**	**Std. Error**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
DOGS (1)	0.546	0.312	1.751	0.080	-0.065	1.156
ID_FEAR	**-0.464**	**0.053**	**8.771**	**< 0.001**	**-0.568**	**-0.360**
AGE (2)	0.132	0.394	0.336	0.737	-0.639	0.904
AGE (3)	-0.193	0.472	0.408	0.683	-1.119	0.733
AGE (4)	**-1.622**	**0.555**	**2.922**	**0.003**	**-2.710**	**-0.534**
POPULATION_SIZE (1)	-0.347	0.340	1.021	0.307	-1.013	0.319
LOSS (1)	-0.119	0.373	0.318	0.751	-0.849	0.612
GENDER (2)	-0.089	0.320	0.278	0.781	-0.715	0.538

**Where: DOGS (1) = livestock owners have guard dogs; ID_FEAR = Fear Index; AGE (2) = 31-45; AGE (3) = 46-60; AGE (4) = >60; POPULATION_SIZE (1) = >1000 habitants; LOSS (1) = Has suffered from wolf predation to livestock; GENDER (2) = Female.*

Hunters

A total of 128 models (Annex IV) were produced, from which only three were considered best model (i.e. ΔAICc < 2; Table 7).

Table 7. *Three Best Models (ΔAICc < 2) for explaining the variability in the Attitude index for the Livestock Owners. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight).*

Model Number	***Gender***	***Population Size***	***Fear Index***	***AICc***	***ΔAICc***	***Akaike Weight***
49		+	-0.693	423.2	0	0.190
33			-0.587	423.7	0.52	0.147
53	+	+	-0.709	424.4	1.17	0.106

"+" indicated that the categorical variable is included in the model

The best model described in Table 8 include the variables *Gender, Population size* and *Fear Index.* These seem to be the most influential variables in explaining the variation in attitude towards the wolf by the hunters. The average model produced using these three models showed that as the *Fear index* value increases the probability to display negative attitudes towards wolves also increases (Table 8). Only this variable presented a coefficient 95% confidence interval that do not include the zero (Table 8). The same reasoning is applied to the variables *Population size* and *Gender*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear)

Table 8. *List of variables included in the average model, produced to assess the diver of hunters Attitudes variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>|z|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero)*.*

					95% Confidence interval	
Independent variables	**β**	**Std. Error**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
POPULATION_SIZE (1)	1.391	0.819	1.698	0.090	-0.215	2.997
ID_FEAR	**-0.662**	**0.159**	**4.162**	**0.000**	**-0.973**	**-0.350**
GENDER (2)	1.248	1.232	1.013	0.311	-1.166	3.663

**Where: POPULATION_SIZE (1) = >1000 habitants; ID_FEAR= Fear Index; GENDER (2) = Female.*

2.8. Factors that Influence the Fear Index by Stakeholder Group

General Public

For the general public a total of 64 models (Annex V) were produced, but only two were considered best model (i.e. ΔAICc < 2; Table 9).

Table 9. *Two Best Models (ΔAICc < 2) for explaining the variability in the Fear index for the General Public. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight). "+" indicated that the categorical variable is included in the model. "+" indicated that the categorical variable is included in the model*

Model Number	***Knowledge of Attack***	***Gender***	***Knowledge Index***	***Population Size***	***AICc***	***ΔAICc***	***Akaike Weight***
30	+	+	+	+	1010.4	0	0.319
14	+	+	+		1010.5	0.07	0.308

"+" indicated that the categorical variable is included in the model

The best model described in Table 10 include the variables *Attacks*, *Gender*, *Knowledge Index* and *Population size*. These seem to be the most influential variables in explaining the variation in fear towards the wolf by the general public. The average model produced using these two models shows that females, people with knowledge of wolf attacks to livestock and those who possess low knowledge regarding wolves' ecology and legislation have higher probability of showing fear towards wolves (Table 10). Only these three variables presented a coefficient 95% confidence interval that do not include the zero, and for that reason it is possible to assess accurately if the influence of the variables is positive or negative (Table 10). The same reasoning is applied to the variable *Population size*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear).

Table 10. *List of variables included in the average model, produced to assess the diver of General Public Fear variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>|z|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero)*.*

					95% Confidence interval	
Independent variables	**β**	**Std. Error**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
ATACKS(1)	**1.302**	**0.471**	**2.763**	**0.006**	**0.378**	**2.225**
GENDER (2)	**1.090**	**0.470**	**2.319**	**0.020**	**0.169**	**2.011**
ID_KNOWLEDGE (1)	**-1.030**	**0.504**	**2.043**	**0.041**	**-2.019**	**-0.042**
ID_KNOWLEDGE (2)	**-2.026**	**0.720**	**2.813**	**0.005**	**-3.437**	**-0.614**
ID_KNOWLEDGE (3)	-1.959	1.038	1.888	0.059	-3.993	0.074
POPULATION_SIZE (1)	-0.796	0.538	1.480	0.139	-1.850	0.258

*Where: *ATTACKS (1) = Has knowledge of wolf predation to livestock;* GENDER (2) = Female; ID_KNOWLEDGE (1) = Knowledge Index value 1; ID_KNOWLEDGE (2) = Knowledge Index value 2; ID_KNOWLEDGE (3) = Knowledge Index value 3; POPULATION_SIZE (1) = >1000 habitants

Livestock Owners

For the Livestock owners a total of 128 models (Annex VI) were produced, but only two models were considered best model (i.e. ΔAICc < 2; Table 11).

Table 11. *Two Best Models (ΔAICc < 2) for explaining the variability in the Fear index for the Livestock Owners. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight).*

Model Number	***Dogs***	***School Level***	***Gender***	***Knowledge Index***	***Animal Loss***	***Population Size***	***AICc***	***ΔAICc***	***Akaike Weight***
63		+	+	+	+	+	806	0	0.272
64	+	+	+	+	+	+	807	0.34	0.23

"+" indicated that the categorical variable is included in the model

The best model described in Table 12 include the variables *Dogs, School, Gender, Knowledge Index, Animal loss* and *Population size*. These seem to be the most influential variables in explaining the variation in fear towards the wolf by the livestock owners. The average model produced using these two models shows that females, people who have suffered livestock losses, have lower knowledge of wolves' ecology and legislation as well as those who inhabit in areas with >1000 inhabitants present a higher probability to show fear towards wolves (Table 12). It also shows that those who have higher educational levels increases the probability for someone to display less fear towards wolves (Table 12). These five variables presented a coefficient 95% confidence interval that do not include the zero (Table 12). The same reasoning is applied to the variable *Dogs*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear).

Table 12. *List of variables included in the average model, produced to assess the diver of Livestock Owners Fear variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>\|z\|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero)*.*

						95% Confidence interval	
Independent variables	**β**	**Std. Error**	**Adjusted SE**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
SCHOOL (2)	-0.387	0.512	0.514	0.754	0.451	-1.395	0.620
SCHOOL (3)	**-1.516**	**0.494**	**0.496**	**3.056**	**0.002**	**-2.488**	**-0.544**
SCHOOL (4)	**-1.271**	**0.413**	**0.415**	**3.063**	**0.002**	**-2.084**	**-0.458**
SCHOOL (5)	**-1.006**	**0.430**	**0.432**	**2.329**	**0.020**	**-1.853**	**-0.160**
GENDER (2)	**0.539**	**0.250**	**0.251**	**2.145**	**0.032**	**0.046**	**1.031**
ID_KNOWLEDGE (1)	**-1.024**	**0.273**	**0.274**	**3.730**	**0.000**	**-1.561**	**-0.486**
ID_KNOWLEDGE (2)	**-1.031**	**0.391**	**0.393**	**2.626**	**0.009**	**-1.801**	**-0.261**
ID_KNOWLEDGE (3)	**-1.946**	**0.421**	**0.423**	**4.602**	**0.000**	**-2.775**	**-1.117**
LOSS (1)	**0.765**	**0.280**	**0.281**	**2.722**	**0.006**	**0.214**	**1.315**
POPULATION_SIZE (1)	**0.693**	**0.268**	**0.269**	**2.575**	**0.010**	**0.166**	**1.221**
DOGS (1)	-0.330	0.240	0.241	1.368	0.171	-0.802	0.143

*Where: SCHOOL (2) = 2nd Cycle; SCHOOL (3) = 3rd Cycle; SCHOOL (4) = Secondary education; SCHOOL (5) = Higher Education; GENDER (2) = Female; ID_KNOWLEDGE (1) = Knowledge Index value 1; ID_KNOWLEDGE (2) = Knowledge Index value 2; ID_KNOWLEDGE (3) = Knowledge Index value 3; LOSS (1) = Has suffered from wolf predation to livestock;. POPULATION_SIZE (1) = >1000 habitants; DOGS (1) = livestock owners have guard dogs.

Hunters

For the hunters, a total of 64 models (Annex VII) were produced, but only five models were considered best model (i.e. ΔAICc < 2; Table 13).

Table 13. *Five Best Models (ΔAICc < 2) for explaining the variability in the Fear index for the Hunters. For each model it is presented the variables that are included, but also the Akaike Information Criterion, adapted for small samples (AICc), the ΔAICc (difference between the model AICc and the lowest estimated AICc for the produced model sets) and the Akaike weight (models Akaike weight).*

Model Number	*Knowledge of Attack*	*School Level*	*Gender*	*Knowledge Index*	*Population Size*	*AICc*	*ΔAICc*	*Akaike Weight*
27		+		+	+	224.4	0	0.176
28	+	+		+	+	224.9	0.51	0.136
20	+	+			+	225.2	0.82	0.117
24	+	+	+		+	225.6	1.17	0.098
31		+	+	+	+	226.3	1.83	0.070

"+" indicated that the categorical variable is included in the model

The best model described in Table 14 include the variables *School level, Attack knowledge*, *Gender*, *Knowledge Index* and *Population size*. These seem to be the most influential variables in explaining the variation in fear towards the wolf by the hunters. The average model produced using these five models shows that people with lower knowledge of wolves' ecology and inhabit areas with >1000 habitants have a higher probability of showing fear towards wolves (Table 14). It also shows that hunters with higher levels of education have a lower probability of showing fear towards wolves (Table 14). Only these

three variables presented a coefficient 95% confidence interval that do not include the zero (Table 14). The same reasoning is applied to the variables *Gender* and *Attack knowledge*, whose coefficient 95% confidence interval includes de zero and therefore we could not determine the direction of it influence (i.e. the model identified that they have influence in the variation of the *Attitude index*, but the way they influence it is not clear).

Table 14. *List of variables included in the average model, produced to assess the diver of Livestock Owners Fear variation. (β – variable coefficient; Std. Error – Standard Error; z-value – Score of the z-test; Pr(>|z|)– significance of the z-test; 95% Confidence Interval – 95% Confidence Interval of each variable coefficient; In bold are highlighted variables whose 95% Confidence Interval of the coefficient does not include the zero).*

						95% Confidence interval	
Independent variables	**β**	**Std. Error**	**Adjusted SE**	**z-value**	**Pr(>|z|)**	**2.50%**	**97.50%**
SCHOOL (3)	-0.455	0.847	0.864	0.526	0.599	-2.148	1.239
SCHOOL (4)	**-1.806**	**0.696**	**0.709**	**2.547**	**0.011**	**-3.196**	**-0.416**
SCHOOL (5)	**-1.873**	**0.722**	**0.735**	**2.548**	**0.011**	**-3.314**	**-0.432**
ID_KNOWLEDGE (1)	**-1.193**	**0.553**	**0.564**	**2.114**	**0.035**	**-2.299**	**-0.087**
ID_KNOWLEDGE (2)	0.779	0.813	0.829	0.940	0.347	-0.846	2.404
ID_KNOWLEDGE (3)	-0.553	0.842	0.857	0.645	0.519	-2.233	1.127
POPULATION_SIZE (1)	**1.601**	**0.562**	**0.571**	**2.805**	**0.005**	**0.482**	**2.719**
ATACKS(1)	1.236	0.708	0.722	1.713	0.087	-0.178	2.650
GENDER (2)	1.242	1.007	1.027	1.210	0.226	-0.770	3.254

*Where: SCHOOL (3) = 3rd Cycle; SCHOOL (4) = Secondary education; SCHOOL (5) = Higher Education;; ID_KNOWLEDGE (1) = Knowledge Index value 1; ID_KNOWLEDGE (2) = Knowledge Index value 2; ID_KNOWLEDGE (3) = Knowledge Index value 3; POPULATION_SIZE (1) = >1000 habitants; ATTACKS (1) = Has knowledge of wolf predation to livestock; GENDER (2) = Female.

2.9. Fear Origin

From the 222 questionnaires that were collected, it was assessed that a total of 56 participants (25%; Figure 14) responded positively to the question if they were afraid of wolves or have any kind of insecurity (either emotional or physical damage) associated to this canid (Figure 14). In these 56 questionnaires that showed that participants were afraid/insecure of wolves, 42.9% mentioned that their fear/insecurity did not derived from myths or ancient stories (Figure 14).

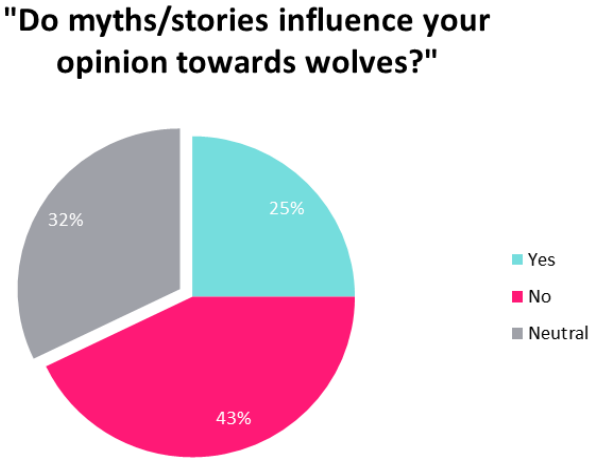


Figure 14. *Percentage of participants that stated that Myth and old stories were on the basis of their fear/insecurity towards wolves.*

2.10. Information Sources

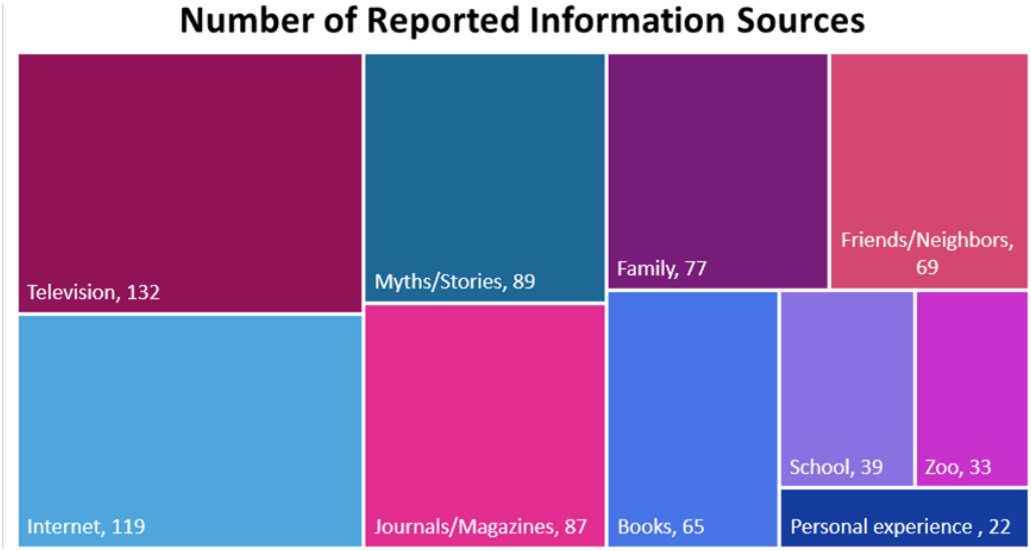


Figure 15. *Resume of wolf ecology/legislation's information source listed by participants.*

We also assessed where participants were collecting their information about wolves' ecology and legislation. Participants identified 732 information sources, and the most common and relevant were: Television, followed by Internet, Myths/old stories and Journals/magazines (Figure 14).

Discussion

Wolves populations in central Portugal are threatened not only by the genetic isolation due to geographical barriers (e.g. Douro river), but also by ecological and biological factors (e.g. small size, decreased genetic variability, and habitat fragmentation), and by the existing conflict. A study conducted in the same area, demonstrated that more than 90% of wolf diet consisted of livestock (Torres *et al.* 2014). But is this the main driver of the detected conflict in the studied area? Livestock depredation, although an influential factor, may not be the most important. Cavalcanti, et al. (2010) have showed that in Pantanal and in the Amazon regions, Brazil, intolerance towards jaguars is influenced not only by the economic impact of jaguar depredation upon domestic animals, but also by fear and sociocultural aspects (e.g. jaguar killing is culturally viewed as an act of bravery) linked to jaguars. In the present study, we hypothesized that local's tolerance to wolf presence was mainly influenced by three aspects: Fear, Knowledge and Attitude, with the first two shaping the last.

3.1. Fear

According to the 2019 Cambridge Dictionary, fear is described as "an unpleasant emotion or thought that you have when you are frightened or worried by something dangerous, painful, or bad that is happening or might happen". It is an ancient strong emotion that influences all conscient life forms, driving an individual not only to respond during dangerous situations, but also when anticipating risk or negative impacts (Laundré *et al.* 2010). Emotions influence how a person interprets, acts or socially interacts (Frijda *et al.* 2000). For this reason, they can be used to predict judgements and decisions an individual may take. It can also influence individuals willingness to support or pay for conservational measurements (Johansson *et al.* 2012). In order to explain an existing conflict, it is necessary to understand the underlying cause of a particular emotion, i.e. the root of its existence, which in this study is fear of wolf. According to Johansson and Karlsson (2011), fear can be defined by four dimensions: the extent of danger, disgust, uncontrol, and unpredictability a person feels upon a live encounter with the animal. Fear of wolf surfaces from cognitive factors, mainly the perception of danger and harm the animal may pose and the unpredictable human response when encountering this predator (Johansson

and Karlsson 2011). By being such a complex emotion, it is an important psychological factor that influence attitudes.

In this study, the *fear index* was considered neutral, tending to low (8,140 from a scale of 3 to 14), meaning that most respondents do not present a fearful behaviour regarding wolves. This tendency was reported previously in the area, by studies initiated in 1994 and 2002 that also showed that fear tended to be neutral (Espirito-Santo 2007). In the current context, a recent study conducted in Bragança (northeastern region of Portugal) has also described fear levels as neutral (Lopes 2017), but lower than the ones obtained in this study area. This discrepancy can be explained by ecological factors, since in Bragança wolves feed predominantly on wild prey (Passinha 2018) portraying a lower risk of wolf predation to livestock in the area (Pimenta *et al.* 2018). Such reality contrast with the situation south of Douro river, where wolves are highly dependent on livestock to survive (Torres *et al.* 2014; Passinha 2018).

Even though no significant differences can be viewed between stakeholder groups, livestock owners' *fear index* tends to be higher than that estimated for other groups, an influential pattern previously described for other wolf population in the Portuguese context (Espirito-Santo 2007; Lopes 2017). This pattern can be due to the fact that most livestock owners live in rural areas, closer to wolf activity centres. It has been demonstrated that inhabitants of rural regions, living closer to wolf areas, display higher fear towards this predator (Johansson *et al.*, 2016). However, a comparison between rural areas, with and without carnivores, is needed (as we did not tested such variation) since it has been reported that rural habitants in carnivore territories are less fearful than those who live in rural areas without carnivores presence (Røskaft *et al.* 2003). And such pattern seems contradictory that the one found in our study.

Curiously, this study demonstrated a puzzling variable influencing fear for two of the stakeholder groups analysed (livestock owners and hunters). Those who inhabit areas with more than 1000 people (whatever the proximity to natural areas) are more predisposed to display higher levels of fear.

Another driver also common to both livestock owners and hunters fear, was the participant *educational level*. In this case, people presenting a higher educational level are more predisposed to display lower levels of fear. The same patter has been observed in other area of Portugal (Lopes 2017) and in Europe (Røskaft *et al.* 2003; Gangaas *et al.* 2014). Other study has demonstrated that lower educational levels predispose people to display higher levels of fear (Zimmermann *et al.* 2001). Studies have demonstrated that personalised educational programs can shape attitudes. A Portuguese study conducted during the course of one year targeting school children, from 6th to the 12th grade, demonstrated that specific educational sessions, focused on the species ecology, function role on ecosystems, etc. can improve knowledge level and, consequently, attitudes towards wolves (Ribeiro 2014). Also, a longitudinal study analysed the effect of the *Marsh Maneuvers* program, a 25 years old American program of environmental education, demonstrated that adults who had participated in this environmental program during summer breaks presented higher knowledge and attitudes more positive regarding the environment, than the control group (Dugas 2018). Although the variable used in this study refers to educational level acquired during school/college years, it seems to have an effect in decreasing the feeling of fear towards wolves. Such patterns may be explained through fear influence on attitudes. Fear is mediated through cognitive appraisal (Rogers 1983) (e.g. personal interpretation of how an stimuli can be perceived as stressful (Campbell *et al.* 2012)), meaning that concern of wolfs' negative impacts may lead to an increase in fear levels since negative situations can induce stress (Bruskotter and Wilson 2014; Tannenbaum *et al.* 2014) which can result in a display of negative attitudes.

Regarding livestock owners and general public fear pattern, this study showed that the main driver of fear was *gender*, with female showing a higher *fear index*, a trait detected not only in Portugal (Lopes 2017), but also in Europe (Røskaft *et al.* 2003; Johansson *et al.* 2016b). A study conducted on fear towards brown bear has showed that poorer perceived physical condition showed a partly correlation with higher fear levels in women, rather than men (Prokop and Fančovičová 2010). Also, women tend to be more emotional honest than men, not having problems in expressing their fear towards wildlife (Kaltenborn *et al.* 2006).

Another variable influencing fear level for both stakeholder groups (i.e. livestock owners and general public) was *having knowledge/suffered livestock depredation*. In the study of Espirito-Santo (2007), the only stakeholder group to mention fear during interviews was the livestock owners, probably due to the associated economic loss (Røskaft *et al.* 2007). However, in our study not only those that were livestock owner have answered that they knew that wolf's prey on livestock, and this shaped their fear level. It is possible to hypothesise that fear may derive from the respondent social context. By simply being informed of wolf depredation events in their community, people may start to perceive the species as dangerous and harmful, even exacerbating towards a scenario of possible attacks to humans (Johansson *et al.* 2016a).

As a matter of fact, this study demonstrated that *knowledge* was the only variable influencing fear levels in all stakeholders' groups. The results showed that those portraying lower levels of knowledge regarding wolves are more probable to display higher levels of fear towards wolves. In Portugal, prior studies only found that knowledge levels only influenced fear in the livestock owners group (Espirito-Santo *et al.* 2016; Lopes 2017). A study conducted in in the Italian and Slovenian Alps demonstrated that environmentalists, mountaineers and hunters, which were the groups presenting lower levels of fear towards wolves, were also associated with higher levels of knowledge (Majić *et al.* 2014). This phenomenon was also found in other conflictual species of large carnivores (Majić *et al.* 2011). Since knowledge about a specie can be obtained through direct experience, the implementation of personalised educational program targeting fear, including outdoor activities, can be used to try and decrease fear levels (Bath and Majic 2000; Røskaft *et al.* 2003). But more formal knowledge transfer, through media mediated tool (e.g. internet, TV or written media) or environmental education action (Ribeiro 2014; Dugas 2018), can also be an effective way to improve ecological literacy, is not contaminated by untruth or exaggerated statements. Nevertheless, while social sciences have been studying the effects of knowledge on fear behaviours for quite some time (Hoffner 1997; Nabi *et al.* 2008), ecologist have been more focused on analysing knowledge in relation with attitude (Bath and Majic 2000; Dorresteijn *et al.* 2016; Espirito-Santo and Petrucci-Fonseca 2017). Most studies regarding human perceptions towards wildlife have focused on assessing variables

(sociodemographic, cultural and environmental) influence on attitudes, overlooking how they may affect emotions towards wildlife, a gap that must be filled.

3.2. Knowledge

Ecological knowledge of a species is crucial to understand its role in the ecosystem trophic chain, mitigate unjustifiable myths, as well as provide critical thinking. This study has demonstrated that knowledge is an influencer of fear (see above, 4.1 Fear). In the literature knowledge has also been identified as an worldwide influencer of Human attitudes, and a determinant of the coexistence between humans and wildlife (Conforti and De Azevedo 2003; Lescureux and Linnell 2010; Behr *et al.* 2017; Anthony and Tarr 2019; Expósito-Granados *et al.* 2019). The term "knowledge" does not refer only to the education received throughout the academic life, but rather to a combination of learnings collected through education and experience. In fact, Zimmermann *et al.* (2001), stated that knowledge level was not solemnly influenced by education level.

The results of this study show that general knowledge about wolves is low in the study area (0.946 out of 5), confirming what other studies have highlighted for Portugal (Espirito-Santo 2007; Espirito-Santo *et al.* 2016; Espirito-Santo and Petrucci-Fonseca 2017; Lopes 2017) Although no significant difference was obtained between groups' knowledge level, the general public scored the lowest level of knowledge, a pattern also evidenced before in Portugal (Lopes 2017), and in Europe (Bath and Majic 2000) This can be explained by distance to the wilderness, knowledge is highly influenced by direct experience and since the general public tend to inhabit further from wolf areas, having thus limited experiences with wolves (direct or indirect) (Røskaft *et al.* 2003). Other studies have also demonstrated that farmers (Tlhaolang 2014; Majić *et al.* 2014; Espirito-Santo and Petrucci-Fonseca 2017), and students (Bath and Majic 2000; Majić *et al.* 2014), can present low level of knowledge. This knowledge variation in the same stakeholder groups may reflect the sampled sites sociodemographic and cultural variables.

Our results also show that the stakeholder groups that evidenced a higher level of knowledge were the hunters, a tendency that was also detected in other Portuguese

regions (Espirito-Santo 2007; Lopes 2017) and in Europe (Tlhaolang 2014; Majić *et al.* 2014), when comparing only this metric for the general public, farmers and hunters. Hunters have a personal relationship with nature, a vast direct and life experience that is translated into their increased knowledge. Aldo Leopold, a renowned hunter and environmentalist has stated this mechanism clearly: "I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view."(Leopold 1950).

The information sources types are considered an important influencer of knowledge. Most of our respondents marked the *television* (18%), *internet* (16.3%), m*yths/stories* (12.2%), j*ournals/magazines* (11.9%), as their major information sources regarding wolves. Other recent study has also detected the same pattern when evaluating wolf's information sources, reporting *television* as the main source of information, followed by *myth/stories*, *internet* and *family* (Lopes 2017). In a recent study conducted in Hungary, television was also reported the main source of information on wolves, followed by other types of media communication (Anthony and Tarr 2019). If such information vehicle is not contaminated by untruth or exaggerated statements, it can be a useful tool in conservation outreach. Inversely, studies have shown that exposure to mediatic and negative information from friends, peers and the media (Karlsson and Sjöström 2007), as well as to culture and tradition, where wolves are portrayed as villains (Chapron *et al.* 2014; van Heel *et al.* 2017), or to negative opinion and believes from family and friends (Anthony and Tarr 2019) can act as a promoter of negative attitudes. On the other hand, Arbieu *et al.* (2019) demonstrated that people with higher knowledge, well informed that reported books and films as the main source of information presented a more tolerant attitude towards wolves. Portugal is a country rich in myths and folklore, some related to the mysticism of wolves (e.g. "Pieira dos lobos" a legend from Ponte de Lima, Northern Portugal, where the 7th daughter of a couples is banished to the mountains to become a wolfs' shepherd). In rural areas these are still an important source of information than can induce fear (Lopes 2017), although this study results seems to indicate that this is not a dominant pattern in the study area. Nevertheless, it is a common belief that wolves are being reintroduced in the country

side, not only in Portugal (Espirito-Santo 2007; Álvares 2011; Lopes 2017), but also in other European countries (Bath and Majic 2000; Hovardas and Korfiatis 2012; Anthony and Tarr 2019). Álvares (2011) hypothesized that this may be due to the lack of knowledge regarding wolves or to a misidentification with feral dog. Whichever the case, such claim can have deleterious effect on wolf conservation, leading to a negative attitude towards wolves.

Overall, it was detected a correlation between knowledge index and attitudes, a pattern vastly reported (Conforti and De Azevedo 2003; Lescureux and Linnell 2010; Behr *et al.* 2017; Anthony and Tarr 2019; Arbieu *et al.* 2019; Expósito-Granados *et al.* 2019), which demonstrates that as the knowledge index increases, the attitudes index tends to become more positive. This is the first time that the relationship between knowledge and attitude are assessed in Portugal, since previous studies have failed to stablish any correlation (Espirito-Santo and Petrucci-Fonseca 2017; Lopes 2017). These results seem contrary to the ones presented in this study, since it was obtained an overall positive *attitude index* but a negative *knowledge index*, although they are not. This has to do with the fact that both index, *knowledge* and *attitude*, are the mean value of all respondents' attitude or knowledge score. On the other hand, index correlation was assessed by the Spearman's rank correlation coefficient, comparing each individual's *knowledge index* with the *attitude index* being able to see that individuals with higher knowledge scores tend to have higher attitude scores. For this reason, it is necessary to approach these data with critical thinking, keeping in mind that these results do not establish causation, only correlation.

3.3. Attitude

Attitude is an important factor depicter of tolerance and can be used to infer how a person might react to the application of conservation measures or act during an encounter with a wild animal. In the study area, attitudes of the inquired persons towards wolves were globally positive (3,557 out of 5). This result is consistent with recent studies conducted in other districts north of Douro river (Milheiras and Hodge 2011; Lopes 2017),

and it can also be seen in other countries with historic wolf presence, such as Italy (Glikman *et al.* 2012). This result also demonstrates that local's attitudes have improved over the last 17 years, evolving from neutral (Espirito-Santo 2007) to positive. This improvement can be a result of increasing environmental conscience through scientific/educational measures (e.g. educational lectures and programs projects, like "Cão de Gado", that promotes wolf conservation by giving shepherd dogs to livestock owners, as a tool to reduce livestock depredation; http://www.grupolobo.pt/programa-cao-de-gado). Although attitudes can improve over time, this result may only be the result of different opinions, since the target individuals in each stakeholder group were different as this was not long-term study analysing the same groups of respondents over time. When analysing separately the different stakeholders' groups' attitudes and its drivers, it was possible to detect that, although every group displayed positive attitudes, significant difference in the main drivers was found. Espirito-Santo (2007) reported that the general public, in the area, was characterized by contrasting attitudes, either strongly negative or strongly positive. The present study demonstrates that the general public attitude has changed, being the group displaying the most positive attitude. A similar pattern where the general public is the stakeholder group with the most positive attitude has been previously reported in Portugal (Lopes 2017), and in Europe (Ericsson and Heberlein 2003; Karlsson and Sjöström 2007; Dressel *et al.* 2014; Arbieu *et al.* 2019). The results showed that the most influential driver of general public's attitude was the *settlement size*, where inhabitants of areas with more than 1000 habitants are more probable to display positive attitudes towards wolves. In fact, it has been discussed that bigger and more densely populated communities tend to be tolerant towards wolves (Kleiven *et al.* 2004; Karlsson and Sjöström 2007; Behr *et al.* 2017). This may be due to the fact that these inhabitants have less probability to have negative experiences with wolves, namely economic threats to their livelihood, or a simple difference in cultural values. Meanwhile, hunters and livestock owners presented a more neutral, although tending to positive, attitude. Hunters attitude towards the wolf in the area appears to remain unchanged since 1995 (Espirito-Santo 2007). This may be due to the fact that traditionally, Portuguese hunters prefer to focus on smaller game species, such as the wild rabbit (*Oryctolagus cuniculus*) and partridge (*Alectoris rufa*), not competing

directly with wolves for game species. Besides the study area, Portuguese hunters tend to present an overall neutral (Lopes 2017) or even positive attitude (Milheiras and Hodge 2011) towards wolves, since direct competition for game species does not occur. Nevertheless this does not mean that hunters attitudes cannot change if an increase in wolfs population occur. This association was described after the Swedish wolves return, where hunters attitudes became more negative (Ericsson and Heberlein 2003). In contrast, European hunters tend to display negative attitudes towards wolves (Karlsson and Sjöström 2007; Behr *et al.* 2017). The group that displayed the most contrasting attitude to the general public pattern, although still neutral, tending to positive, were the livestock owners. This group is widely depicted as the least tolerant stakeholder towards wolves, not only in the Portuguese population (Espirito-Santo 2007; Milheiras and Hodge 2011; Lopes 2017)but also in Slovakia, Netherlands as well as other European regions (Rigg *et al.* 2011; Dressel *et al.* 2014; van Heel *et al.* 2017), mainly due to direct conflict. This conflict may arise from direct negative experiences or from reports of negative impact of the species (i.e. acquaintances that suffered livestock depredation by wolves), leading to the development of negative feelings towards the species, identifying wolves as a harmful species (Dressel *et al.* 2014; Behr *et al.* 2017; van Heel *et al.* 2017). The results also demonstrated that the most influential variable shaping livestock owners' attitudes towards wolves was related to their *age* – individuals older than 65 years old will evidence a higher probability to display negative attitudes towards wolves. The trend of decrease in tolerance with the increasing of age has been described in other European regions (Bjerke *et al.* 1998; Ericsson and Heberlein 2003; Røskaft *et al.* 2003, 2007; Kleiven *et al.* 2004). Such pattern can be related to the fact that older livestock owners tend to be long time habitants of rural areas, where they were exposed to a culture of intolerance towards wolves during their childhood. This related to the fact that they probably have sustained prolonged exposer to negative interactions with wolves through the course of their life and eventually have suffered predation events by wolves (Røskaft *et al.* 2003). All these facts may be enough to explain this trend.

Nevertheless, another variable was identified in all the stakeholder' groups as an important driver: the *fear index*. The general pattern was that the higher the *fear index*,

the more probable was for someone to display negative attitudes. The negative influence of fear on people attitudes towards wolves has been vastly reported for several wolf populations (Røskaft *et al.* 2003, 2007; Kleiven *et al.* 2004; Johansson and Karlsson 2011; Bruskotter and Wilson 2014; Behr *et al.* 2017). Humans fear towards wolves is mainly based on individual perception of danger/harm predators may pose and how unpredictable a person's may react during a wolf encounter (Johansson and Karlsson 2011). This means that high levels of fear are often associated to stress inducing situations, normally fear of attacks, influencing how wolves are perceived, consequent decreasing human tolerance for these predators (See above 4.1 Fear, page 55; Bruskotter and Wilson 2014).

Final Considerations

Attitudes are not the product of a single feeling or thought, but they are shaped by experience, sociodemographic, school and cultural environments since the individuals' childhood. In this thesis we provided evidence that, in central Portugal, attitudes towards wolves were generally positive. Attitudes were influenced positively by Human population settlement's size (areas with >1000 habitants), and negatively by Fear and Age (>65 tend to have more negatives attitudes). Regarding *Fear Index*, it was strongly influenced by gender (female showed higher *fear index*) and low knowledge regarding wolves. Several studies focused on the impact of knowledge on attitudes, but although it may be helpful to measure the population interest/knowledge regarding a subject, its assessment alone, cannot be used as a predictor of attitude. Although we successfully demonstrated that higher knowledge is correlated with less fear and more positives attitudes, and that socio-demographic factors, such as age and gender, influence this index, other variables not considered in our study might also be influencing the attitude: *Trust* (believing that you can trust someone/something (Cambridge University Press 2019)), *Acceptance* (agreement that something is right, satisfactory, agreeing and accepting someone/something (Cambridge University Press 2019)) and *Quality of information Source* (how reliable, good/bad information sources are (Cambridge University Press 2019)). Attitudes are being studied since the 1920's by social sciences, and although conclusions may be optimistic it is important to have in mind that even if we can change attitudes, this will not imply a change in behaviour.

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Annex

Annex I *– Questionnaire*

Grupo I – Dados pessoais (Todas as informações são confidenciais)

Género: **a)** Feminino **b)** Masculino **Idade:** _____

Local de residência:

Freguesia_____ Concelho_____

Profissão_____ **Grau de escolaridade** _____

Possui gado doméstico? SIM☐ NÃO☐ **Se sim, possui cão guarda/gado?** SIM☐ NÃO☐

É caçador/Possui licença de caça? SIM☐ NÃO☐

Grupo II – As seguintes perguntas são sobre experiências pessoais com o lobo. Por favor, assinale a resposta que melhor descreve a sua.

1) Já avistou lobos no seu local de residência?	Sim	Não	Sem opinião
2) Tem conhecimento de ataques de lobos a animais doméstico?	Sim	Não	Sem opinião
3) Já sofreu perdas de animais domésticos por ataque de lobos?	Sim	Não	Sem opinião
4) Tem conhecimento de ataques de lobos a humanos?	Sim	Não	Sem opinião
5) Quando o lobo ataca um animal doméstico, o proprietário é compensado?	Sim	Não	Sem opinião
6) Já houve reintroduções de lobos em Portugal?	Sim	Não	Sem opinião
7) O lobo alimenta-se principalmente de animais de caça maior	Sim	Não	Sem opinião
8) Na sua região, a população de lobos na sua zona tem aumentado	Sim	Não	Sem opinião
9) Na sua região, o número de ataques de lobos a gado tem aumentado	Sim	Não	Sem opinião

Grupo III - Por favor, coloque um círculo na resposta que melhor descreve a sua opinião utilizando a seguinte escala: **1=Discordo absolutamente; 2=Discordo; 3=Sem opinião; 4=Concordo; 5=Concordo absolutamente**

1) As matilhas de cães assilvestrados são mais perigosas que os lobos	1	2	3	4	5
2) É importante manter as populações de lobo para as gerações futuras	1	2	3	4	5
3) A presença de lobo na zona onde vive causa-lhe medo/insegurança	1	2	3	4	5
4) Ainda que haja lobos noutros países europeus, é importante também haver lobos em Portugal	1	2	3	4	5

5) Os mitos e histórias antigas influenciam a sua atitude em relação ao lobo	1	2	3	4	5
6) O lobo é perigoso para o Homem	1	2	3	4	5
7) É capaz de tolerar a presença de lobos perto da sua casa	1	2	3	4	5
8) Os lobos devem ser eliminados quando matam gado doméstico	1	2	3	4	5
9) O lobo deveria estar confinado a zonas fechadas/cercadas	1	2	3	4	5
10) É importante haver populações de lobos na sua região	1	2	3	4	5
11) Nutro um sentimento positivo em relação aos lobos	1	2	3	4	5
12) A presença do lobo na região é uma mais-valia para o turismo	1	2	3	4	5
13) O lobo é sinal de uma natureza intacta.	1	2	3	4	5
14) Os lobos desempenham uma importante função ecológica	1	2	3	4	5
15) Ver um lobo na natureza seria para si uma experiência excitante	1	2	3	4	5

Grupo IV - As seguintes perguntas são sobre a influência dos meios de comunicação sobre o conhecimento geral sobre os lobos. Utilize a seguinte escala: **1=Discordo absolutamente; 2=Discordo; 3=Sem opinião; 4=Concordo; 5=Concordo absolutamente**

1) Costuma ver notícias (jornais/televisão) sobre ataques de lobo a gado doméstico	1	2	3	4	5
2) É comum exagerarem nas notícias de ataques de lobo ao gado doméstico	1	2	3	4	5
3) Os meios de comunicação defendem os lobos	1	2	3	4	5
4) Existe falta de cobertura dos ataques de lobos pelos meios de comunicação	1	2	3	4	5

5) Quais são as suas fontes de informação sobre o lobo?

☐ Jornais/Revistas ☐ Jardim Zoológicos ☐ Internet

☐ Livros ☐ Professores/Escola ☐ Amigo/Vizinho

☐ Televisão ☐ Familiares ☐ Mitos/Histórias antigas

Outras:_____

Obrigada Pela Sua Participação

Annex II – Models explaining factors influence on General Public *attitude* towards wolves

	Knowledge of Attack	*School Level*	*Gender*	*Knowledge Index*	*Population Size*	*Fear Index*	*Age*	*df*	*logLik*	*AICc*	*ΔAICc*	*Akaike Weight*
49	NA	NA	NA	NA	+	-0.473	NA	6	-976.994	1966.090	0.000	0.269
53	NA	NA	+	NA	+	-0.465	NA	7	-976.494	1967.123	1.033	0.161
50	+	NA	NA	NA	+	-0.467	NA	7	-976.683	1967.501	1.411	0.123
54	+	NA	+	NA	+	-0.456	NA	8	-975.992	1968.149	2.069	0.096
57	NA	NA	NA	+	+	-0.459	NA	9	-975.464	1969.148	3.057	0.058
112	NA	NA	NA	NA	+	-0.469	+	9	-976.014	1970.248	4.147	0.034
61	NA	NA	+	+	+	-0.454	NA	10	-975.145	1970.559	4.468	0.029
58	+	NA	NA	+	+	-0.454	NA	10	-975.235	1970.738	4.648	0.026
117	NA	NA	+	NA	+	-0.462	+	10	-975.510	1971.288	5.198	0.020
51	NA	+	NA	NA	+	-0.473	NA	10	-975.603	1971.473	5.382	0.018
55	NA	+	+	NA	+	-0.462	NA	11	-974.608	1971.538	5.448	0.018
62	+	NA	+	+	+	-0.446	NA	11	-974.778	1971.878	5.788	0.014
114	+	NA	NA	NA	+	-0.465	+	10	-975.860	1971.989	5.898	0.014
56	+	+	+	NA	+	-0.452	NA	12	-974.129	1972.639	6.548	0.010
33	NA	NA	NA	NA	NA	-0.478	NA	5	-981.304	1972.681	6.590	0.010
118	+	NA	+	NA	+	-0.455	+	11	-975.221	1972.764	6.674	0.010
52	+	+	NA	NA	+	-0.467	NA	11	-975.359	1973.040	6.949	0.008
59	NA	+	NA	+	+	-0.459	NA	12	-973.527	1973.499	7.409	0.007
121	NA	NA	NA	+	+	-0.459	+	12	-974.591	1973.562	7.472	0.006
34	+	NA	NA	NA	NA	-0.470	NA	6	-980.794	1973.689	7.599	0.006
63	NA	+	+	+	+	-0.449	NA	14	-972.790	1974.094	8.003	0.005
37	NA	NA	+	NA	NA	-0.474	NA	6	-981.178	1974.457	8.367	0.004
114	NA	+	NA	NA	+	-0.468	+	12	-974.192	1974.828	8.738	0.003
125	NA	NA	+	+	+	-0.453	+	12	-974.250	1974.944	8.853	0.003
119	NA	+	+	NA	+	-0.457	+	14	-973.246	1975.006	8.914	0.003

38	+	NA	+	NA	NA	-0.463	NA	7	-980.533	1975.201	9.111	0.003
60	+	+	NA	+	+	-0.455	NA	14	-973.401	1975.316	9.226	0.003
122	+	NA	NA	+	+	-0.455	+	12	-974.490	1975.425	9.335	0.003
35	NA	+	NA	NA	NA	-0.481	NA	9	-978.624	1975.466	9.375	0.002
64	+	+	+	+	+	-0.442	NA	14	-972.500	1975.588	9.498	0.002
97	NA	NA	NA	NA	NA	-0.476	+	8	-980.091	1976.356	10.266	0.002
39	NA	+	+	NA	NA	-0.473	NA	10	-978.066	1976.400	10.309	0.002
120	+	+	+	NA	+	-0.450	+	14	-972.990	1976.567	10.477	0.001
126	+	NA	+	+	+	-0.447	+	14	-974.054	1976.622	10.532	0.001
41	NA	NA	NA	+	NA	-0.472	NA	8	-980.254	1976.682	10.592	0.001
116	+	+	NA	NA	+	-0.464	+	14	-974.096	1976.706	10.614	0.001
36	+	+	NA	NA	NA	-0.474	NA	10	-978.332	1976.932	10.842	0.001
123	NA	+	NA	+	+	-0.456	+	16	-972.310	1977.287	11.197	0.001
40	+	+	+	NA	NA	-0.463	NA	11	-977.585	1977.491	11.400	0.001
42	+	NA	NA	+	NA	-0.464	NA	9	-979.821	1977.861	11.770	0.001
98	+	NA	NA	NA	NA	-0.470	+	9	-979.823	1977.864	11.774	0.001
43	NA	+	NA	+	NA	-0.470	NA	12	-976.755	1977.891	11.800	0.001
127	NA	+	+	+	+	-0.447	+	17	-971.607	1977.966	11.875	0.001
101	NA	NA	+	NA	NA	-0.472	+	9	-979.932	1978.083	11.992	0.001
99	NA	+	NA	NA	NA	-0.475	+	12	-977.026	1978.432	12.342	0.001
45	NA	NA	+	+	NA	-0.470	NA	9	-980.216	1978.651	12.561	0.001
47	NA	+	+	+	NA	-0.464	NA	12	-976.421	1979.287	12.197	0.000
124	+	+	NA	+	+	-0.454	+	17	-972.273	1979.297	12.206	0.000
102	+	NA	+	NA	NA	-0.464	+	10	-979.562	1979.391	12.301	0.000
103	NA	+	+	NA	NA	-0.467	+	12	-976.525	1979.495	12.405	0.000
44	+	+	NA	+	NA	-0.466	NA	12	-976.582	1979.609	12.519	0.000
46	+	NA	+	+	NA	-0.460	NA	10	-979.704	1979.676	12.585	0.000
128	+	+	+	+	+	-0.442	+	18	-971.468	1979.777	12.687	0.000
105	NA	NA	NA	+	NA	-0.471	+	11	-978.916	1980.143	14.063	0.000
100	+	+	NA	NA	NA	-0.471	+	12	-976.906	1980.257	14.166	0.000

48	+	+	+	+	NA	-0.457	NA	14	-976.124	1980.762	14.672	0.000
104	+	+	+	NA	NA	-0.461	+	14	-976.282	1981.078	14.988	0.000
107	NA	+	NA	+	NA	-0.466	+	14	-975.260	1981.108	14.018	0.000
106	+	NA	NA	+	NA	-0.466	+	12	-978.714	1981.811	14.720	0.000
109	NA	NA	+	+	NA	-0.469	+	12	-978.848	1982.076	14.985	0.000
111	NA	+	+	+	NA	-0.461	+	16	-974.947	1982.562	16.471	0.000
108	+	+	NA	+	NA	-0.464	+	16	-975.204	1983.075	16.985	0.000
110	+	NA	+	+	NA	-0.462	+	12	-978.584	1983.612	17.523	0.000
112	+	+	+	+	NA	-0.456	+	17	-974.818	1984.387	18.297	0.000
30	+	NA	+	+	+	NA	NA	10	-1023.758	2067.784	101.694	0.000
22	+	NA	+	NA	+	NA	NA	7	-1028.392	2070.919	104.829	0.000
32	+	+	+	+	+	NA	NA	14	-1021.642	2071.797	105.707	0.000
29	NA	NA	+	+	+	NA	NA	9	-1027.350	2072.919	106.829	0.000
94	+	NA	+	+	+	NA	+	12	-1023.342	2073.128	107.037	0.000
26	+	NA	NA	+	+	NA	NA	9	-1027.481	2073.181	107.091	0.000
24	+	+	+	NA	+	NA	NA	11	-1026.270	2074.861	108.771	0.000
6	+	NA	+	NA	NA	NA	NA	6	-1031.391	2074.885	108.794	0.000
86	+	NA	+	NA	+	NA	+	10	-1027.317	2074.901	108.810	0.000
14	+	NA	+	+	NA	NA	NA	9	-1028.341	2074.901	108.810	0.000
25	NA	NA	NA	+	+	NA	NA	8	-1029.986	2076.147	110.057	0.000
96	+	+	+	+	+	NA	+	17	-1020.931	2076.612	110.522	0.000
31	NA	+	+	+	+	NA	NA	12	-1025.316	2077.076	110.986	0.000
93	NA	NA	+	+	+	NA	+	12	-1026.424	2077.228	111.128	0.000
21	NA	NA	+	NA	+	NA	NA	6	-1032.685	2077.472	111.382	0.000
90	+	NA	NA	+	+	NA	+	12	-1026.720	2077.820	111.730	0.000
16	+	+	+	+	NA	NA	NA	12	-1025.722	2077.888	111.798	0.000
18	+	NA	NA	NA	+	NA	NA	6	-1032.948	2077.997	111.907	0.000
10	+	NA	NA	+	NA	NA	NA	8	-1031.010	2078.195	112.104	0.000
88	+	+	+	NA	+	NA	+	14	-1024.887	2078.288	112.198	0.000
70	+	NA	+	NA	NA	NA	+	9	-1030.334	2078.887	112.796	0.000

8	+	+	+	NA	NA	NA	NA	10	-1029.395	2079.057	112.967	0.000
28	+	+	NA	+	+	NA	NA	12	-1026.478	2079.400	112.310	0.000
78	+	NA	+	+	NA	NA	+	12	-1027.668	2079.717	112.626	0.000
85	NA	NA	+	NA	+	NA	+	9	-1030.859	2079.937	112.846	0.000
2	+	NA	NA	NA	NA	NA	NA	5	-1034.964	2080.001	112.910	0.000
89	NA	NA	NA	+	+	NA	+	11	-1028.855	2080.031	112.941	0.000
95	NA	+	+	+	+	NA	+	16	-1024.035	2080.737	114.646	0.000
12	NA	NA	+	+	NA	NA	NA	8	-1032.290	2080.755	114.664	0.000
82	+	NA	NA	NA	+	NA	+	9	-1031.367	2080.952	114.861	0.000
23	NA	+	+	NA	+	NA	NA	10	-1030.814	2081.898	114.808	0.000
5	NA	NA	+	NA	NA	NA	NA	5	-1035.917	2081.906	114.816	0.000
80	+	+	+	+	NA	NA	+	16	-1024.664	2081.996	114.905	0.000
9	NA	NA	NA	+	NA	NA	NA	7	-1033.960	2082.056	114.965	0.000
17	NA	NA	NA	NA	+	NA	NA	5	-1036.014	2082.101	116.011	0.000
72	+	+	+	NA	NA	NA	+	12	-1027.859	2082.162	116.071	0.000
27	NA	+	NA	+	+	NA	NA	12	-1028.900	2082.181	116.091	0.000
74	+	NA	NA	+	NA	NA	+	11	-1030.122	2082.586	116.496	0.000
14	NA	+	+	+	NA	NA	NA	12	-1029.400	2083.181	117.091	0.000
66	+	NA	NA	NA	NA	NA	+	8	-1033.514	2083.203	117.112	0.000
92	+	+	NA	+	+	NA	+	16	-1025.311	2083.289	117.198	0.000
12	+	+	NA	+	NA	NA	NA	12	-1029.525	2083.431	117.341	0.000
87	NA	+	+	NA	+	NA	+	12	-1028.582	2083.609	117.519	0.000
81	NA	NA	NA	NA	+	NA	+	8	-1033.860	2083.896	117.805	0.000
20	+	+	NA	NA	+	NA	NA	10	-1031.866	2083.999	117.909	0.000
77	NA	NA	+	+	NA	NA	+	11	-1030.920	2084.162	118.071	0.000
69	NA	NA	+	NA	NA	NA	+	8	-1033.999	2084.172	118.081	0.000
1	NA	NA	NA	NA	NA	NA	NA	4	-1038.335	2084.718	118.627	0.000
91	NA	+	NA	+	+	NA	+	14	-1027.300	2085.188	119.098	0.000
73	NA	NA	NA	+	NA	NA	+	10	-1032.535	2085.337	119.246	0.000
79	NA	+	+	+	NA	NA	+	14	-1027.676	2085.940	119.850	0.000

7	NA	+	+	NA	NA	NA	NA	9	-1033.908	2086.035	119.945	0.000
4	+	+	NA	NA	NA	NA	NA	9	-1034.064	2086.347	120.257	0.000
11	NA	+	NA	+	NA	NA	NA	11	-1032.082	2086.486	120.396	0.000
84	+	+	NA	NA	+	NA	+	12	-1030.041	2086.526	120.435	0.000
65	NA	NA	NA	NA	NA	NA	+	7	-1036.211	2086.557	120.466	0.000
76	+	+	NA	+	NA	NA	+	14	-1028.043	2086.674	120.584	0.000
71	NA	+	+	NA	NA	NA	+	12	-1031.452	2087.285	121.195	0.000
19	NA	+	NA	NA	+	NA	NA	9	-1035.036	2088.290	122.200	0.000
68	+	+	NA	NA	NA	NA	+	12	-1032.051	2088.482	122.392	0.000
75	NA	+	NA	+	NA	NA	+	14	-1030.087	2088.687	122.596	0.000
83	NA	+	NA	NA	+	NA	+	12	-1032.509	2089.399	123.309	0.000
3	NA	+	NA	NA	NA	NA	NA	8	-1037.319	2090.812	124.722	0.000
67	NA	+	NA	NA	NA	NA	+	11	-1034.552	2091.426	125.336	0.000

Annex III – Models explaining factors influence on Livestock Owners *attitude* towards wolves

	Dogs	*School Level*	*Gender*	*Knowledge Index*	*Animal Loss*	*Population Size*	*Fear Index*	*Age*	*df*	*logLik*	*AICc*	*ΔAICc*	*Akaike Weight*
194	+	NA	NA	NA	NA	NA	-0.466	+	9	-794.236	1606.770	0.000	0.149
193	NA	NA	NA	NA	NA	NA	-0.470	+	8	-795.731	1607.699	0.929	0.100
226	+	NA	NA	NA	NA	+	-0.456	+	10	-793.720	1607.803	1.033	0.095
210	+	NA	NA	NA	+	NA	-0.461	+	10	-794.186	1608.736	1.966	0.060
198	+	NA	+	NA	NA	NA	-0.464	+	10	-794.198	1608.760	1.990	0.059
225	NA	NA	NA	NA	NA	+	-0.461	+	9	-795.273	1608.843	2.073	0.056
242	+	NA	NA	NA	+	+	-0.449	+	11	-793.614	1609.666	2.896	0.037
197	NA	NA	+	NA	NA	NA	-0.468	+	9	-795.700	1609.696	2.926	0.037
209	NA	NA	NA	NA	+	NA	-0.471	+	9	-795.730	1609.756	2.986	0.036
230	+	NA	+	NA	NA	+	-0.456	+	11	-793.711	1609.859	3.089	0.034
214	+	NA	+	NA	+	NA	-0.459	+	11	-794.124	1610.705	3.935	0.022
229	NA	NA	+	NA	NA	+	-0.460	+	10	-795.267	1610.897	4.127	0.020
241	NA	NA	NA	NA	+	+	-0.460	+	10	-795.271	1610.905	4.125	0.020
202	+	NA	NA	+	NA	NA	-0.445	+	12	-793.336	1611.189	4.419	0.017
246	+	NA	+	NA	+	+	-0.448	+	12	-793.597	1611.712	4.942	0.012
212	NA	NA	+	NA	+	NA	-0.468	+	10	-795.699	1611.762	4.992	0.012
234	+	NA	NA	+	NA	+	-0.437	+	12	-792.855	1612.314	5.544	0.010
68	+	+	NA	NA	NA	NA	-0.476	NA	10	-796.059	1612.482	5.712	0.009
66	+	NA	NA	NA	NA	NA	-0.482	NA	6	-800.193	1612.525	5.755	0.009
201	NA	NA	NA	+	NA	NA	-0.453	+	11	-795.059	1612.555	5.785	0.009
65	NA	NA	NA	NA	NA	NA	-0.488	NA	5	-801.302	1612.703	5.933	0.008
67	NA	+	NA	NA	NA	NA	-0.481	NA	9	-797.223	1612.743	5.973	0.008
245	NA	NA	+	NA	+	+	-0.459	+	11	-795.263	1612.964	6.194	0.007
206	+	NA	+	+	NA	NA	-0.442	+	12	-793.250	1612.105	6.335	0.007
218	+	NA	NA	+	+	NA	-0.441	+	12	-793.289	1612.183	6.412	0.006

100	+	+	NA	NA	NA	+	-0.462	NA	11	-795.412	1612.263	6.493	0.006
99	NA	+	NA	NA	NA	+	-0.466	NA	10	-796.578	1612.520	6.750	0.005
196	+	+	NA	NA	NA	NA	-0.464	+	12	-793.482	1612.568	6.798	0.005
228	+	+	NA	NA	NA	+	-0.451	+	14	-792.528	1612.755	6.985	0.005
233	NA	NA	NA	+	NA	+	-0.444	+	12	-794.653	1612.823	7.053	0.005
72	+	+	+	NA	NA	NA	-0.470	NA	11	-795.698	1612.833	7.063	0.005
71	NA	+	+	NA	NA	NA	-0.475	NA	10	-796.885	1614.124	7.364	0.004
195	NA	+	NA	NA	NA	NA	-0.467	+	12	-794.840	1614.198	7.428	0.004
250	+	NA	NA	+	+	+	-0.430	+	14	-792.757	1614.212	7.443	0.004
238	+	NA	+	+	NA	+	-0.434	+	14	-792.812	1614.324	7.554	0.004
70	+	NA	+	NA	NA	NA	-0.479	NA	7	-800.084	1614.351	7.581	0.004
205	NA	NA	+	+	NA	NA	-0.449	+	12	-794.999	1614.514	7.745	0.003
82	+	NA	NA	NA	+	NA	-0.480	NA	7	-800.169	1614.521	7.751	0.003
84	+	+	NA	NA	+	NA	-0.477	NA	11	-796.053	1614.543	7.773	0.003
69	NA	NA	+	NA	NA	NA	-0.485	NA	6	-801.209	1614.557	7.787	0.003
98	+	NA	NA	NA	NA	+	-0.484	NA	7	-800.187	1614.558	7.788	0.003
83	NA	+	NA	NA	+	NA	-0.486	NA	10	-797.101	1614.566	7.796	0.003
227	NA	+	NA	NA	NA	+	-0.454	+	12	-794.003	1614.610	7.840	0.003
217	NA	NA	NA	+	+	NA	-0.454	+	12	-795.055	1614.627	7.857	0.003
81	NA	NA	NA	NA	+	NA	-0.490	NA	6	-801.294	1614.726	7.956	0.003
97	NA	NA	NA	NA	NA	+	-0.489	NA	6	-801.301	1614.739	7.969	0.003
104	+	+	+	NA	NA	+	-0.457	NA	12	-795.122	1614.782	8.012	0.003
222	+	NA	+	+	+	NA	-0.436	+	14	-793.185	1614.069	8.299	0.003
103	NA	+	+	NA	NA	+	-0.462	NA	11	-796.319	1614.075	8.305	0.003
116	+	+	NA	NA	+	+	-0.460	NA	12	-795.409	1614.336	8.566	0.002
200	+	+	+	NA	NA	NA	-0.461	+	14	-793.343	1614.384	8.614	0.002
114	NA	+	NA	NA	+	+	-0.470	NA	11	-796.529	1614.495	8.725	0.002
212	+	+	NA	NA	+	NA	-0.461	+	14	-793.457	1614.614	8.844	0.002
244	+	+	NA	NA	+	+	-0.444	+	14	-792.432	1614.664	8.894	0.002
76	+	+	NA	+	NA	NA	-0.440	NA	12	-794.557	1614.719	8.949	0.002

232	+	+	+	NA	NA	+	-0.449	+	14	-792.469	1614.737	8.967	0.002
237	NA	NA	+	+	NA	+	-0.443	+	12	-794.626	1614.856	9.086	0.002
249	NA	NA	NA	+	+	+	-0.444	+	12	-794.653	1614.910	9.140	0.002
88	+	+	+	NA	+	NA	-0.470	NA	12	-795.698	1614.912	9.143	0.002
199	NA	+	+	NA	NA	NA	-0.463	+	12	-794.696	1614.996	9.226	0.002
87	NA	+	+	NA	+	NA	-0.480	NA	11	-796.797	1616.032	9.262	0.002
75	NA	+	NA	+	NA	NA	-0.446	NA	12	-795.805	1616.127	9.357	0.001
254	+	NA	+	+	+	+	-0.427	+	14	-792.699	1616.197	9.427	0.001
211	NA	+	NA	NA	+	NA	-0.469	+	12	-794.823	1616.250	9.480	0.001
86	+	NA	+	NA	+	NA	-0.475	NA	8	-800.043	1616.324	9.554	0.001
102	+	NA	+	NA	NA	+	-0.481	NA	8	-800.071	1616.379	9.609	0.001
114	+	NA	NA	NA	+	+	-0.481	NA	8	-800.166	1616.568	9.798	0.001
231	NA	+	+	NA	NA	+	-0.451	+	14	-793.935	1616.569	9.799	0.001
101	NA	NA	+	NA	NA	+	-0.486	NA	7	-801.204	1616.593	9.823	0.001
85	NA	NA	+	NA	+	NA	-0.486	NA	7	-801.206	1616.597	9.827	0.001
221	NA	NA	+	+	+	NA	-0.450	+	12	-794.997	1616.600	9.830	0.001
108	+	+	NA	+	NA	+	-0.427	NA	14	-793.968	1616.635	9.865	0.001
243	NA	+	NA	NA	+	+	-0.454	+	14	-794.003	1616.704	9.934	0.001
80	+	+	+	+	NA	NA	-0.431	NA	14	-794.032	1616.762	9.992	0.001
112	NA	NA	NA	NA	+	+	-0.491	NA	7	-801.291	1616.766	9.996	0.001
120	+	+	+	NA	+	+	-0.455	NA	12	-795.121	1616.847	10.077	0.001
119	NA	+	+	NA	+	+	-0.465	NA	12	-796.286	1617.089	10.319	0.001
107	NA	+	NA	+	NA	+	-0.434	NA	12	-795.251	1617.107	10.337	0.001
79	NA	+	+	+	NA	NA	-0.437	NA	12	-795.353	1617.311	10.541	0.001
216	+	+	+	NA	+	NA	-0.457	+	14	-793.306	1617.412	10.643	0.001
248	+	+	+	NA	+	+	-0.441	+	16	-792.360	1617.629	10.859	0.001
74	+	NA	NA	+	NA	NA	-0.466	NA	9	-799.674	1617.644	10.874	0.001
73	NA	NA	NA	+	NA	NA	-0.473	NA	8	-800.773	1617.784	11.014	0.001
92	+	+	NA	+	+	NA	-0.441	NA	14	-794.553	1617.806	11.036	0.001
112	+	+	+	+	NA	+	-0.419	NA	14	-793.503	1617.806	11.036	0.001

204	+	+	NA	+	NA	NA	-0.439	+	16	-792.475	1617.859	11.089	0.001
236	+	+	NA	+	NA	+	-0.424	+	17	-791.458	1617.939	11.169	0.001
253	NA	NA	+	+	+	+	-0.442	+	14	-794.625	1617.948	11.178	0.001
91	NA	+	NA	+	+	NA	-0.452	NA	12	-795.692	1617.989	11.219	0.001
214	NA	+	+	NA	+	NA	-0.464	+	14	-794.686	1618.071	11.301	0.001
118	+	NA	+	NA	+	+	-0.477	NA	9	-800.036	1618.370	11.600	0.000
111	NA	+	+	+	NA	+	-0.426	NA	14	-794.855	1618.409	11.639	0.000
117	NA	NA	+	NA	+	+	-0.487	NA	8	-801.200	1618.637	11.867	0.000
247	NA	+	+	NA	+	+	-0.451	+	14	-793.935	1618.670	11.900	0.000
124	+	+	NA	+	+	+	-0.426	NA	14	-793.965	1618.731	11.961	0.000
203	NA	+	NA	+	NA	NA	-0.444	+	14	-794.020	1618.840	12.070	0.000
96	+	+	+	+	+	NA	-0.431	NA	14	-794.032	1618.863	12.093	0.000
123	NA	+	NA	+	+	+	-0.438	NA	14	-795.195	1619.089	12.319	0.000
95	NA	+	+	+	+	NA	-0.442	NA	14	-795.270	1619.240	12.470	0.000
235	NA	+	NA	+	NA	+	-0.430	+	16	-793.178	1619.264	12.494	0.000
78	+	NA	+	+	NA	NA	-0.462	NA	10	-799.556	1619.476	12.706	0.000
208	+	+	+	+	NA	NA	-0.432	+	17	-792.228	1619.480	12.710	0.000
90	+	NA	NA	+	+	NA	-0.461	NA	10	-799.616	1619.596	12.826	0.000
106	+	NA	NA	+	NA	+	-0.469	NA	10	-799.623	1619.609	12.839	0.000
77	NA	NA	+	+	NA	NA	-0.469	NA	9	-800.685	1619.667	12.897	0.000
240	+	+	+	+	NA	+	-0.419	+	18	-791.298	1619.742	12.972	0.000
105	NA	NA	NA	+	NA	+	-0.475	NA	9	-800.737	1619.771	12.001	0.000
89	NA	NA	NA	+	+	NA	-0.473	NA	9	-800.773	1619.843	12.073	0.000
128	+	+	+	+	+	+	-0.417	NA	16	-793.492	1619.892	12.122	0.000
252	+	+	NA	+	+	+	-0.419	+	18	-791.386	1619.918	12.148	0.000
220	+	+	NA	+	+	NA	-0.437	+	17	-792.462	1619.947	12.177	0.000
127	NA	+	+	+	+	+	-0.429	NA	14	-794.816	1620.433	12.663	0.000
207	NA	+	+	+	NA	NA	-0.437	+	16	-793.797	1620.502	12.732	0.000
219	NA	+	NA	+	+	NA	-0.447	+	16	-793.985	1620.879	14.109	0.000
239	NA	+	+	+	NA	+	-0.425	+	17	-793.032	1621.086	14.316	0.000

251	NA	+	NA	+	+	+	-0.432	+	17	-793.173	1621.369	14.599	0.000
94	+	NA	+	+	+	NA	-0.456	NA	11	-799.476	1621.390	14.620	0.000
110	+	NA	+	+	NA	+	-0.464	NA	11	-799.489	1621.414	14.645	0.000
224	+	+	+	+	+	NA	-0.429	+	18	-792.204	1621.554	14.784	0.000
122	+	NA	NA	+	+	+	-0.464	NA	11	-799.579	1621.595	14.825	0.000
109	NA	NA	+	+	NA	+	-0.471	NA	10	-800.637	1621.638	14.868	0.000
256	+	+	+	+	+	+	-0.412	+	19	-791.212	1621.700	14.930	0.000
93	NA	NA	+	+	+	NA	-0.468	NA	10	-800.684	1621.733	14.963	0.000
121	NA	NA	NA	+	+	+	-0.476	NA	10	-800.736	1621.835	14.065	0.000
223	NA	+	+	+	+	NA	-0.440	+	17	-793.773	1622.570	14.800	0.000
255	NA	+	+	+	+	+	-0.426	+	18	-793.029	1623.204	16.434	0.000
126	+	NA	+	+	+	+	-0.459	NA	12	-799.427	1623.371	16.601	0.000
125	NA	NA	+	+	+	+	-0.472	NA	11	-800.637	1623.712	16.942	0.000
64	+	+	+	+	+	+	NA	NA	14	-816.365	1663.531	56.761	0.000
190	+	NA	+	+	+	+	NA	+	14	-817.503	1663.706	56.936	0.000
186	+	NA	NA	+	+	+	NA	+	12	-818.645	1663.894	57.124	0.000
48	+	+	+	+	NA	+	NA	NA	14	-817.882	1664.463	57.693	0.000
148	+	NA	+	+	+	NA	NA	+	12	-819.120	1664.865	58.095	0.000
47	NA	+	+	+	NA	+	NA	NA	12	-819.293	1665.191	58.421	0.000
60	+	+	NA	+	+	+	NA	NA	14	-818.253	1665.205	58.435	0.000
178	+	NA	NA	NA	+	+	NA	+	10	-822.447	1665.257	58.487	0.000
63	NA	+	+	+	+	+	NA	NA	14	-818.473	1665.645	58.875	0.000
182	+	NA	+	NA	+	+	NA	+	11	-821.682	1665.800	59.030	0.000
144	+	NA	NA	+	+	NA	NA	+	12	-820.673	1665.863	59.093	0.000
44	+	+	NA	+	NA	+	NA	NA	12	-819.632	1665.868	59.098	0.000
192	+	+	+	+	+	+	NA	+	18	-814.416	1665.978	59.208	0.000
32	+	+	+	+	+	NA	NA	NA	14	-818.801	1666.300	59.530	0.000
43	NA	+	NA	+	NA	+	NA	NA	12	-820.940	1666.397	59.627	0.000
170	+	NA	NA	+	NA	+	NA	+	12	-820.991	1666.499	59.729	0.000
16	+	+	+	+	NA	NA	NA	NA	12	-819.984	1666.572	59.802	0.000

188	+	+	NA	+	+	+	NA	+	17	-814.775	1666.574	59.804	0.000
174	+	NA	+	+	NA	+	NA	+	12	-820.066	1666.736	59.966	0.000
185	NA	NA	NA	+	+	+	NA	+	12	-821.210	1666.937	60.167	0.000
189	NA	NA	+	+	+	+	NA	+	12	-820.192	1666.990	60.220	0.000
59	NA	+	NA	+	+	+	NA	NA	12	-820.193	1666.991	60.221	0.000
14	NA	+	+	+	NA	NA	NA	NA	12	-821.341	1667.200	60.430	0.000
177	NA	NA	NA	NA	+	+	NA	+	9	-824.477	1667.252	60.482	0.000
142	+	NA	+	+	NA	NA	NA	+	12	-821.368	1667.253	60.483	0.000
140	+	NA	+	NA	+	NA	NA	+	10	-823.614	1667.594	60.824	0.000
128	+	NA	NA	+	NA	NA	NA	+	11	-822.632	1667.701	60.931	0.000
147	NA	NA	+	+	+	NA	NA	+	12	-821.597	1667.712	60.942	0.000
146	+	NA	NA	NA	+	NA	NA	+	9	-824.788	1667.873	61.103	0.000
169	NA	NA	NA	+	NA	+	NA	+	11	-822.720	1667.877	61.107	0.000
181	NA	NA	+	NA	+	+	NA	+	10	-823.769	1667.902	61.122	0.000
176	+	+	+	+	NA	+	NA	+	17	-816.458	1667.939	61.169	0.000
31	NA	+	+	+	+	NA	NA	NA	12	-820.740	1668.084	61.314	0.000
173	NA	NA	+	+	NA	+	NA	+	12	-821.852	1668.222	61.452	0.000
143	NA	NA	NA	+	+	NA	NA	+	11	-822.975	1668.387	61.617	0.000
172	+	+	NA	+	NA	+	NA	+	16	-817.740	1668.388	61.618	0.000
141	NA	NA	+	+	NA	NA	NA	+	11	-823.039	1668.514	61.744	0.000
191	NA	+	+	+	+	+	NA	+	17	-816.793	1668.610	61.840	0.000
12	+	+	NA	+	NA	NA	NA	NA	12	-822.048	1668.612	61.843	0.000
28	+	+	NA	+	+	NA	NA	NA	12	-821.016	1668.637	61.867	0.000
127	NA	NA	NA	+	NA	NA	NA	+	10	-824.224	1668.812	62.042	0.000
175	NA	+	+	+	NA	+	NA	+	16	-817.970	1668.847	62.077	0.000
162	+	NA	NA	NA	NA	+	NA	+	9	-825.275	1668.847	62.077	0.000
11	NA	+	NA	+	NA	NA	NA	NA	11	-823.294	1669.026	62.256	0.000
160	+	+	+	+	+	NA	NA	+	17	-817.032	1669.087	62.317	0.000
187	NA	+	NA	+	+	+	NA	+	16	-818.114	1669.128	62.368	0.000
161	NA	NA	NA	NA	NA	+	NA	+	8	-826.476	1669.190	62.420	0.000

171	NA	+	NA	+	NA	+	NA	+	14	-819.240	1669.280	62.510	0.000
149	NA	NA	+	NA	+	NA	NA	+	9	-825.496	1669.290	62.520	0.000
145	NA	NA	NA	NA	+	NA	NA	+	8	-826.580	1669.397	62.627	0.000
166	+	NA	+	NA	NA	+	NA	+	10	-824.730	1669.823	63.053	0.000
27	NA	+	NA	+	+	NA	NA	NA	12	-822.775	1670.067	63.297	0.000
165	NA	NA	+	NA	NA	+	NA	+	9	-825.940	1670.178	63.408	0.000
144	+	+	+	+	NA	NA	NA	+	16	-818.641	1670.190	63.420	0.000
180	+	+	NA	NA	+	+	NA	+	14	-820.784	1670.268	63.498	0.000
30	+	NA	+	+	+	NA	NA	NA	10	-824.965	1670.294	63.524	0.000
120	+	NA	NA	NA	NA	NA	NA	+	8	-827.181	1670.599	63.829	0.000
146	+	+	NA	+	+	NA	NA	+	16	-818.848	1670.604	63.834	0.000
143	NA	+	+	+	NA	NA	NA	+	14	-819.917	1670.634	63.864	0.000
184	+	+	+	NA	+	+	NA	+	14	-819.940	1670.681	63.911	0.000
129	NA	NA	NA	NA	NA	NA	NA	+	7	-828.265	1670.714	63.945	0.000
149	NA	+	+	+	+	NA	NA	+	16	-818.987	1670.882	64.112	0.000
124	+	NA	+	NA	NA	NA	NA	+	9	-826.308	1670.912	64.142	0.000
123	NA	NA	+	NA	NA	NA	NA	+	8	-827.414	1671.066	64.296	0.000
26	+	NA	NA	+	+	NA	NA	NA	9	-826.551	1671.398	64.628	0.000
140	+	+	NA	+	NA	NA	NA	+	14	-820.340	1671.481	64.711	0.000
62	+	NA	+	+	+	+	NA	NA	11	-824.637	1671.710	64.940	0.000
129	NA	+	NA	+	NA	NA	NA	+	14	-821.585	1671.868	65.098	0.000
179	NA	+	NA	NA	+	+	NA	+	12	-822.647	1671.898	65.128	0.000
145	NA	+	NA	+	+	NA	NA	+	14	-820.730	1672.261	65.491	0.000
183	NA	+	+	NA	+	+	NA	+	14	-821.781	1672.261	65.491	0.000
29	NA	NA	+	+	+	NA	NA	NA	9	-827.065	1672.427	65.657	0.000
58	+	NA	NA	+	+	+	NA	NA	10	-826.066	1672.496	65.726	0.000
14	+	NA	+	+	NA	NA	NA	NA	9	-827.121	1672.538	65.768	0.000
56	+	+	+	NA	+	+	NA	NA	12	-824.034	1672.585	65.814	0.000
52	+	+	NA	NA	+	+	NA	NA	11	-825.261	1672.959	66.189	0.000
10	+	NA	NA	+	NA	NA	NA	NA	8	-828.435	1673.107	66.337	0.000

12	NA	NA	+	+	NA	NA	NA	NA	8	-828.450	1673.127	66.367	0.000
25	NA	NA	NA	+	+	NA	NA	NA	8	-828.478	1673.193	66.423	0.000
163	NA	+	NA	NA	NA	+	NA	+	12	-824.473	1673.463	66.693	0.000
9	NA	NA	NA	+	NA	NA	NA	NA	7	-829.681	1673.546	66.776	0.000
164	+	+	NA	NA	NA	+	NA	+	12	-823.501	1673.607	66.837	0.000
61	NA	NA	+	+	+	+	NA	NA	10	-826.712	1673.788	67.018	0.000
167	NA	+	+	NA	NA	+	NA	+	12	-823.706	1674.016	67.246	0.000
55	NA	+	+	NA	+	+	NA	NA	11	-825.806	1674.049	67.279	0.000
142	+	+	+	NA	+	NA	NA	+	14	-822.681	1674.060	67.290	0.000
54	+	NA	+	NA	+	+	NA	NA	8	-828.961	1674.149	67.389	0.000
22	+	NA	+	NA	+	NA	NA	NA	7	-830.020	1674.225	67.455	0.000
168	+	+	+	NA	NA	+	NA	+	14	-822.767	1674.233	67.463	0.000
46	+	NA	+	+	NA	+	NA	NA	10	-826.939	1674.242	67.472	0.000
57	NA	NA	NA	+	+	+	NA	NA	9	-827.975	1674.247	67.477	0.000
50	+	NA	NA	NA	+	+	NA	NA	7	-830.042	1674.268	67.498	0.000
51	NA	+	NA	NA	+	+	NA	NA	10	-826.965	1674.294	67.524	0.000
39	NA	+	+	NA	NA	+	NA	NA	10	-827.041	1674.446	67.676	0.000
35	NA	+	NA	NA	NA	+	NA	NA	9	-828.088	1674.472	67.702	0.000
40	+	+	+	NA	NA	+	NA	NA	11	-826.018	1674.474	67.704	0.000
36	+	+	NA	NA	NA	+	NA	NA	10	-827.085	1674.534	67.764	0.000
42	+	NA	NA	+	NA	+	NA	NA	9	-828.127	1674.571	67.801	0.000
148	+	+	NA	NA	+	NA	NA	+	12	-824.016	1674.637	67.867	0.000
45	NA	NA	+	+	NA	+	NA	NA	9	-828.231	1674.759	67.989	0.000
18	+	NA	NA	NA	+	NA	NA	NA	6	-831.347	1674.833	68.063	0.000
41	NA	NA	NA	+	NA	+	NA	NA	8	-829.342	1674.920	68.140	0.000
141	NA	+	+	NA	+	NA	NA	+	12	-824.181	1674.966	68.196	0.000
147	NA	+	NA	NA	+	NA	NA	+	12	-825.512	1675.541	68.771	0.000
49	NA	NA	NA	NA	+	+	NA	NA	6	-831.793	1675.723	68.953	0.000
53	NA	NA	+	NA	+	+	NA	NA	7	-830.818	1675.821	69.051	0.000
21	NA	NA	+	NA	+	NA	NA	NA	6	-831.916	1675.970	69.200	0.000

125	NA	+	+	NA	NA	NA	NA	+	12	-825.766	1676.050	69.280	0.000
121	NA	+	NA	NA	NA	NA	NA	+	11	-826.951	1676.339	69.569	0.000
17	NA	NA	NA	NA	+	NA	NA	NA	5	-833.127	1676.353	69.583	0.000
6	+	NA	+	NA	NA	NA	NA	NA	6	-832.110	1676.357	69.587	0.000
2	+	NA	NA	NA	NA	NA	NA	NA	5	-833.149	1676.416	69.646	0.000
34	+	NA	NA	NA	NA	+	NA	NA	6	-832.182	1676.501	69.731	0.000
33	NA	NA	NA	NA	NA	+	NA	NA	5	-833.237	1676.572	69.802	0.000
126	+	+	+	NA	NA	NA	NA	+	12	-824.988	1676.581	69.811	0.000
1	NA	NA	NA	NA	NA	NA	NA	NA	4	-834.286	1676.638	69.868	0.000
5	NA	NA	+	NA	NA	NA	NA	NA	5	-833.275	1676.649	69.879	0.000
122	+	+	NA	NA	NA	NA	NA	+	12	-826.149	1676.816	70.046	0.000
38	+	NA	+	NA	NA	+	NA	NA	7	-831.335	1676.855	70.085	0.000
24	+	+	+	NA	+	NA	NA	NA	11	-827.223	1676.883	70.112	0.000
37	NA	NA	+	NA	NA	+	NA	NA	6	-832.432	1677.001	70.231	0.000
7	NA	+	+	NA	NA	NA	NA	NA	9	-829.737	1677.771	71.001	0.000
8	+	+	+	NA	NA	NA	NA	NA	10	-828.717	1677.799	71.029	0.000
23	NA	+	+	NA	+	NA	NA	NA	10	-828.867	1678.097	71.327	0.000
20	+	+	NA	NA	+	NA	NA	NA	10	-828.887	1678.128	71.368	0.000
3	NA	+	NA	NA	NA	NA	NA	NA	8	-831.186	1678.610	71.840	0.000
4	+	+	NA	NA	NA	NA	NA	NA	9	-830.188	1678.673	71.903	0.000
19	NA	+	NA	NA	+	NA	NA	NA	9	-830.450	1679.197	72.427	0.000

Annex IV – Models explaining factors influence on Hunters *attitude* towards wolves

	Knowledge of Attack	***School Level***	***Gender***	***Knowledge Index***	***Population Size***	***Fear Index***	***Age***	***df***	***logLik***	***AICc***	***ΔAICc***	***Akaike Weight***
49	NA	NA	NA	NA	+	-0.693	NA	6	-205.332	423.185	0.000	0.190
33	NA	NA	NA	NA	NA	-0.587	NA	5	-206.665	423.701	0.516	0.147
53	NA	NA	+	NA	+	-0.709	NA	7	-204.828	424.355	1.170	0.106
50	+	NA	NA	NA	+	-0.684	NA	7	-205.272	425.244	2.058	0.068
57	NA	NA	NA	+	+	-0.746	NA	9	-203.060	425.259	2.074	0.067
37	NA	NA	+	NA	NA	-0.593	NA	6	-206.402	425.327	2.141	0.065
34	+	NA	NA	NA	NA	-0.577	NA	6	-206.597	425.714	2.530	0.054
54	+	NA	+	NA	+	-0.709	NA	8	-204.828	426.561	3.376	0.035
61	NA	NA	+	+	+	-0.761	NA	10	-202.794	426.990	3.804	0.028
58	+	NA	NA	+	+	-0.740	NA	10	-202.987	427.375	4.190	0.023
41	NA	NA	NA	+	NA	-0.572	NA	8	-205.237	427.379	4.194	0.023
38	+	NA	+	NA	NA	-0.589	NA	7	-206.392	427.484	4.299	0.022
35	NA	+	NA	NA	NA	-0.481	NA	8	-205.388	427.682	4.497	0.020
51	NA	+	NA	NA	+	-0.591	NA	9	-204.427	427.994	4.808	0.017
112	NA	NA	NA	NA	+	-0.680	+	9	-204.688	428.516	5.330	0.012
62	+	NA	+	+	+	-0.758	NA	11	-202.782	429.256	6.071	0.009
97	NA	NA	NA	NA	NA	-0.570	+	8	-206.183	429.271	6.086	0.009
36	+	+	NA	NA	NA	-0.459	NA	9	-205.162	429.464	6.279	0.008
45	NA	NA	+	+	NA	-0.576	NA	9	-205.175	429.489	6.304	0.008
117	NA	NA	+	NA	+	-0.706	+	10	-204.063	429.527	6.342	0.008
42	+	NA	NA	+	NA	-0.567	NA	9	-205.209	429.557	6.372	0.008
39	NA	+	+	NA	NA	-0.498	NA	9	-205.220	429.579	6.394	0.008
55	NA	+	+	NA	+	-0.623	NA	10	-204.090	429.582	6.396	0.008
52	+	+	NA	NA	+	-0.569	NA	10	-204.230	429.861	6.676	0.007
114	+	NA	NA	NA	+	-0.669	+	10	-204.574	430.550	7.365	0.005

101	NA	NA	+	NA	NA	-0.579	+	9	-205.933	431.006	7.821	0.004
98	+	NA	NA	NA	NA	-0.559	+	9	-206.086	431.311	8.126	0.003
40	+	+	+	NA	NA	-0.475	NA	10	-205.099	431.600	8.414	0.003
121	NA	NA	NA	+	+	-0.753	+	12	-202.810	431.632	8.447	0.003
59	NA	+	NA	+	+	-0.678	NA	12	-202.823	431.659	8.474	0.003
46	+	NA	+	+	NA	-0.572	NA	10	-205.166	431.733	8.547	0.003
56	+	+	+	NA	+	-0.604	NA	11	-204.032	431.756	8.571	0.003
118	+	NA	+	NA	+	-0.701	+	11	-204.050	431.792	8.607	0.003
43	NA	+	NA	+	NA	-0.455	NA	11	-204.208	432.109	8.924	0.002
125	NA	NA	+	+	+	-0.780	+	12	-202.404	433.171	9.986	0.001
102	+	NA	+	NA	NA	-0.572	+	10	-205.903	433.207	10.022	0.001
114	NA	+	NA	NA	+	-0.587	+	12	-203.791	433.595	10.410	0.001
63	NA	+	+	+	+	-0.700	NA	12	-202.654	433.672	10.487	0.001
122	+	NA	NA	+	+	-0.748	+	12	-202.698	433.760	10.575	0.001
60	+	+	NA	+	+	-0.664	NA	12	-202.704	433.772	10.587	0.001
99	NA	+	NA	NA	NA	-0.452	+	11	-205.046	433.785	10.600	0.001
105	NA	NA	NA	+	NA	-0.576	+	11	-205.140	433.972	10.786	0.001
44	+	+	NA	+	NA	-0.439	NA	12	-204.089	434.191	11.006	0.001
47	NA	+	+	+	NA	-0.461	NA	12	-204.162	434.337	11.141	0.001
119	NA	+	+	NA	+	-0.659	+	12	-203.312	434.989	11.804	0.001
3	NA	+	NA	NA	NA	NA	NA	7	-210.250	435.200	12.014	0.000
116	+	+	NA	NA	+	-0.572	+	12	-203.558	435.480	12.295	0.000
126	+	NA	+	+	+	-0.775	+	14	-202.370	435.485	12.299	0.000
4	+	+	NA	NA	NA	NA	NA	8	-209.425	435.756	12.571	0.000
100	+	+	NA	NA	NA	-0.437	+	12	-204.886	435.785	12.600	0.000
103	NA	+	+	NA	NA	-0.473	+	12	-204.960	435.933	12.747	0.000
64	+	+	+	+	+	-0.686	NA	14	-202.610	435.966	12.780	0.000
109	NA	NA	+	+	NA	-0.581	+	12	-205.073	436.149	12.973	0.000
106	+	NA	NA	+	NA	-0.571	+	12	-205.104	436.221	12.036	0.000
48	+	+	+	+	NA	-0.444	NA	12	-204.079	436.521	12.336	0.000

19	NA	+	NA	NA	+	NA	NA	8	-210.147	437.200	14.014	0.000
120	+	+	+	NA	+	-0.640	+	14	-203.230	437.204	14.019	0.000
1	NA	NA	NA	NA	NA	NA	NA	4	-214.485	437.214	14.030	0.000
7	NA	+	+	NA	NA	NA	NA	8	-210.228	437.361	14.176	0.000
8	+	+	+	NA	NA	NA	NA	9	-209.235	437.609	14.423	0.000
11	NA	+	NA	+	NA	NA	NA	10	-208.203	437.806	14.621	0.000
20	+	+	NA	NA	+	NA	NA	9	-209.363	437.865	14.680	0.000
104	+	+	+	NA	NA	-0.452	+	12	-204.855	438.075	14.889	0.000
123	NA	+	NA	+	+	-0.691	+	14	-202.470	438.098	14.912	0.000
2	+	NA	NA	NA	NA	NA	NA	5	-212.893	438.147	14.971	0.000
110	+	NA	+	+	NA	-0.577	+	12	-205.056	438.475	14.290	0.000
107	NA	+	NA	+	NA	-0.437	+	14	-204.082	438.910	14.724	0.000
17	NA	NA	NA	NA	+	NA	NA	5	-214.294	438.959	14.774	0.000
12	+	+	NA	+	NA	NA	NA	11	-207.678	439.049	14.863	0.000
5	NA	NA	+	NA	NA	NA	NA	5	-214.463	439.296	16.111	0.000
23	NA	+	+	NA	+	NA	NA	9	-210.125	439.388	16.203	0.000
27	NA	+	NA	+	+	NA	NA	11	-207.897	439.486	16.301	0.000
67	NA	+	NA	NA	NA	NA	+	10	-209.129	439.660	16.474	0.000
24	+	+	+	NA	+	NA	NA	10	-209.176	439.754	16.568	0.000
18	+	NA	NA	NA	+	NA	NA	6	-212.754	440.029	16.844	0.000
127	NA	+	+	+	+	-0.748	+	16	-202.231	440.065	16.880	0.000
14	NA	+	+	+	NA	NA	NA	11	-208.193	440.079	16.894	0.000
124	+	+	NA	+	+	-0.684	+	16	-202.310	440.223	17.038	0.000
6	+	NA	+	NA	NA	NA	NA	6	-212.888	440.298	17.112	0.000
9	NA	NA	NA	+	NA	NA	NA	7	-212.950	440.599	17.414	0.000
68	+	+	NA	NA	NA	NA	+	11	-208.606	440.905	17.720	0.000
28	+	+	NA	+	+	NA	NA	12	-207.461	440.935	17.750	0.000
21	NA	NA	+	NA	+	NA	NA	6	-214.281	441.084	17.898	0.000
16	+	+	+	+	NA	NA	NA	12	-207.570	441.143	17.968	0.000
108	+	+	NA	+	NA	-0.426	+	14	-204.008	441.173	17.988	0.000

111	NA	+	+	+	NA	-0.440	+	14	-204.079	441.314	18.120	0.000
71	NA	+	+	NA	NA	NA	+	11	-208.946	441.585	18.400	0.000
65	NA	NA	NA	NA	NA	NA	+	7	-212.473	441.647	18.461	0.000
31	NA	+	+	+	+	NA	NA	12	-207.887	441.786	18.601	0.000
83	NA	+	NA	NA	+	NA	+	11	-209.094	441.880	18.695	0.000
10	+	NA	NA	+	NA	NA	NA	8	-212.585	442.076	18.891	0.000
25	NA	NA	NA	+	+	NA	NA	8	-212.621	442.147	18.962	0.000
22	+	NA	+	NA	+	NA	NA	7	-212.745	442.191	19.005	0.000
128	+	+	+	+	+	-0.734	+	17	-202.145	442.391	19.206	0.000
72	+	+	+	NA	NA	NA	+	12	-208.235	442.483	19.297	0.000
66	+	NA	NA	NA	NA	NA	+	8	-212.936	442.778	19.593	0.000
12	NA	NA	+	+	NA	NA	NA	8	-212.950	442.805	19.620	0.000
32	+	+	+	+	+	NA	NA	12	-207.362	443.087	19.901	0.000
84	+	+	NA	NA	+	NA	+	12	-208.601	443.214	20.030	0.000
75	NA	+	NA	+	NA	NA	+	12	-207.464	443.292	20.107	0.000
81	NA	NA	NA	NA	+	NA	+	8	-212.343	443.592	20.407	0.000
112	+	+	+	+	NA	-0.425	+	16	-204.007	443.617	20.432	0.000
26	+	NA	NA	+	+	NA	NA	9	-212.338	443.816	20.631	0.000
87	NA	+	+	NA	+	NA	+	12	-208.902	443.818	20.633	0.000
69	NA	NA	+	NA	NA	NA	+	8	-212.467	443.840	20.655	0.000
14	+	NA	+	+	NA	NA	NA	9	-212.558	444.256	21.070	0.000
29	NA	NA	+	+	+	NA	NA	9	-212.618	444.375	21.190	0.000
88	+	+	+	NA	+	NA	+	12	-208.227	444.818	21.633	0.000
82	+	NA	NA	NA	+	NA	+	9	-212.859	444.858	21.672	0.000
70	+	NA	+	NA	NA	NA	+	9	-212.925	444.989	21.804	0.000
76	+	+	NA	+	NA	NA	+	14	-207.140	445.025	21.840	0.000
79	NA	+	+	+	NA	NA	+	14	-207.277	445.299	22.114	0.000
91	NA	+	NA	+	+	NA	+	14	-207.289	445.324	22.129	0.000
85	NA	NA	+	NA	+	NA	+	9	-212.342	445.822	22.637	0.000
30	+	NA	+	+	+	NA	NA	10	-212.300	446.001	22.816	0.000

73	NA	NA	NA	+	NA	NA	+	10	-212.601	446.604	23.419	0.000
80	+	+	+	+	NA	NA	+	14	-206.814	446.787	23.602	0.000
86	+	NA	+	NA	+	NA	+	10	-212.842	447.086	23.900	0.000
92	+	+	NA	+	+	NA	+	14	-207.036	447.230	24.045	0.000
95	NA	+	+	+	+	NA	+	14	-207.093	447.343	24.148	0.000
74	+	NA	NA	+	NA	NA	+	11	-212.254	448.200	25.014	0.000
89	NA	NA	NA	+	+	NA	+	11	-212.342	448.376	25.191	0.000
77	NA	NA	+	+	NA	NA	+	11	-212.600	448.893	25.707	0.000
96	+	+	+	+	+	NA	+	16	-206.714	449.031	25.846	0.000
90	+	NA	NA	+	+	NA	+	12	-212.077	450.167	26.982	0.000
78	+	NA	+	+	NA	NA	+	12	-212.229	450.470	27.285	0.000
93	NA	NA	+	+	+	NA	+	12	-212.331	450.674	27.489	0.000
94	+	NA	+	+	+	NA	+	12	-212.036	452.435	29.250	0.000

Annex V – Models explaining factors influence on General Public *fear* towards wolves

	Knowledge of Attack	***School Level***	***Gender***	***Knowledge Index***	***Population Size***	***Age***	***df***	***logLik***	***AICc***	***ΔAICc***	***Akaike Weight***
30	+	NA	+	+	+	NA	10	-494.885	1010.407	0.000	0.319
14	+	NA	+	+	NA	NA	9	-495.980	1010.480	0.073	0.308
10	+	NA	NA	+	NA	NA	8	-498.467	1012.349	2.942	0.073
6	+	NA	+	NA	NA	NA	6	-500.911	1014.062	3.656	0.051
26	+	NA	NA	+	+	NA	9	-497.789	1014.097	3.690	0.050
22	+	NA	+	NA	+	NA	7	-500.610	1014.542	5.125	0.024
29	NA	NA	+	+	+	NA	9	-498.624	1014.767	5.360	0.022
46	+	NA	+	+	NA	+	12	-495.469	1014.845	5.438	0.021
62	+	NA	+	+	+	+	12	-494.441	1014.943	5.536	0.020
12	NA	NA	+	+	NA	NA	8	-499.914	1016.241	5.834	0.017
9	NA	NA	NA	+	NA	NA	7	-501.468	1017.257	6.850	0.010
32	+	+	+	+	+	NA	14	-494.045	1017.317	6.910	0.010
25	NA	NA	NA	+	+	NA	8	-500.577	1017.567	7.161	0.009
38	+	NA	+	NA	NA	+	9	-499.561	1017.640	7.233	0.009
16	+	+	+	+	NA	NA	12	-495.364	1017.788	7.382	0.008
42	+	NA	NA	+	NA	+	11	-497.699	1018.162	7.756	0.007
2	+	NA	NA	NA	NA	NA	5	-504.178	1018.528	8.121	0.006
58	+	NA	NA	+	+	+	12	-497.022	1018.950	8.543	0.004
54	+	NA	+	NA	+	+	10	-499.214	1019.063	8.656	0.004
61	NA	NA	+	+	+	+	12	-497.714	1020.338	9.931	0.002
5	NA	NA	+	NA	NA	NA	5	-505.112	1020.394	9.988	0.002
18	+	NA	NA	NA	+	NA	6	-504.095	1020.431	10.024	0.002
45	NA	NA	+	+	NA	+	11	-498.847	1020.459	10.052	0.002
8	+	+	+	NA	NA	NA	10	-500.029	1020.694	10.287	0.002
41	NA	NA	NA	+	NA	+	10	-500.277	1021.189	10.782	0.001

34	+	NA	NA	NA	NA	+	8	-502.407	1021.227	10.820	0.001
12	+	+	NA	+	NA	NA	12	-498.181	1021.269	10.862	0.001
24	+	+	+	NA	+	NA	11	-499.349	1021.463	11.056	0.001
21	NA	NA	+	NA	+	NA	6	-504.711	1021.662	11.256	0.001
28	+	+	NA	+	+	NA	12	-497.311	1021.683	11.276	0.001
57	NA	NA	NA	+	+	+	11	-499.465	1021.694	11.288	0.001
37	NA	NA	+	NA	NA	+	8	-503.058	1022.530	12.123	0.001
1	NA	NA	NA	NA	NA	NA	4	-507.336	1022.786	12.380	0.001
64	+	+	+	+	+	+	17	-493.543	1022.891	12.484	0.001
31	NA	+	+	+	+	NA	12	-497.961	1022.983	12.577	0.001
48	+	+	+	+	NA	+	16	-494.723	1023.045	12.638	0.001
50	+	NA	NA	NA	+	+	9	-502.272	1023.062	12.655	0.001
14	NA	+	+	+	NA	NA	12	-499.281	1023.469	12.062	0.000
53	NA	NA	+	NA	+	+	9	-502.645	1023.810	12.403	0.000
40	+	+	+	NA	NA	+	12	-498.576	1024.214	12.807	0.000
33	NA	NA	NA	NA	NA	+	7	-505.027	1024.374	12.968	0.000
17	NA	NA	NA	NA	+	NA	5	-507.173	1024.517	14.111	0.000
11	NA	+	NA	+	NA	NA	11	-501.125	1025.035	14.628	0.000
56	+	+	+	NA	+	+	14	-497.912	1025.055	14.648	0.000
27	NA	+	NA	+	+	NA	12	-500.190	1025.287	14.880	0.000
4	+	+	NA	NA	NA	NA	9	-503.401	1025.321	14.914	0.000
44	+	+	NA	+	NA	+	14	-497.297	1026.002	14.595	0.000
49	NA	NA	NA	NA	+	+	8	-504.826	1026.066	14.659	0.000
60	+	+	NA	+	+	+	16	-496.546	1026.692	16.285	0.000
20	+	+	NA	NA	+	NA	10	-503.031	1026.697	16.290	0.000
7	NA	+	+	NA	NA	NA	9	-504.424	1027.368	16.961	0.000
63	NA	+	+	+	+	+	16	-496.976	1027.552	17.145	0.000
47	NA	+	+	+	NA	+	14	-498.101	1027.610	17.203	0.000
23	NA	+	+	NA	+	NA	10	-503.741	1028.118	17.711	0.000
36	+	+	NA	NA	NA	+	12	-501.728	1028.363	17.956	0.000

43	NA	+	NA	+	NA	+	14	-499.806	1028.839	18.432	0.000
39	NA	+	+	NA	NA	+	12	-502.231	1029.370	18.963	0.000
59	NA	+	NA	+	+	+	14	-499.026	1029.460	19.053	0.000
52	+	+	NA	NA	+	+	12	-501.394	1029.850	19.443	0.000
3	NA	+	NA	NA	NA	NA	8	-506.777	1029.967	19.560	0.000
55	NA	+	+	NA	+	+	12	-501.602	1030.266	19.859	0.000
19	NA	+	NA	NA	+	NA	9	-506.361	1031.241	20.834	0.000
35	NA	+	NA	NA	NA	+	11	-504.452	1031.670	21.263	0.000
51	NA	+	NA	NA	+	+	12	-504.099	1033.104	22.697	0.000

Annex VI – Models explaining factors influence on Livestock Owners *fear* towards wolves

	Dogs	*School Level*	*Gender*	*Knowledge Index*	*Animal Loss*	*Population Size*	*Age*	*df*	*logLik*	*AICc*	*ΔAICc*	*Akaike Weight*
63	NA	+	+	+	+	+	NA	12	-389.379	806.214	0.000	0.272
64	+	+	+	+	+	+	NA	14	-388.432	806.550	0.335	0.230
59	NA	+	NA	+	+	+	NA	12	-391.693	808.629	2.414	0.081
60	+	+	NA	+	+	+	NA	12	-390.794	809.044	2.829	0.066
127	NA	+	+	+	+	+	+	16	-387.960	810.123	3.908	0.039
31	NA	+	+	+	+	NA	NA	12	-392.729	810.700	4.486	0.029
62	+	NA	+	+	+	+	NA	10	-395.045	810.961	4.746	0.025
47	NA	+	+	+	NA	+	NA	12	-392.954	811.141	4.936	0.023
128	+	+	+	+	+	+	+	17	-387.367	811.221	5.006	0.022
32	+	+	+	+	+	NA	NA	12	-391.883	811.222	5.008	0.022
61	NA	NA	+	+	+	+	NA	9	-396.307	811.323	5.108	0.021
95	NA	+	+	+	+	NA	+	14	-390.109	812.144	5.939	0.014
30	+	NA	+	+	+	NA	NA	9	-396.745	812.198	5.983	0.014
125	NA	NA	+	+	+	+	+	12	-393.557	812.357	6.142	0.012
126	+	NA	+	+	+	+	+	12	-392.572	812.599	6.385	0.011
29	NA	NA	+	+	+	NA	NA	8	-398.020	812.605	6.391	0.011
123	NA	+	NA	+	+	+	+	14	-390.452	812.840	6.625	0.010
48	+	+	+	+	NA	+	NA	12	-392.711	812.878	6.663	0.010
93	NA	NA	+	+	+	NA	+	11	-395.080	812.207	6.992	0.008
43	NA	+	NA	+	NA	+	NA	11	-395.140	812.327	7.112	0.008
96	+	+	+	+	+	NA	+	16	-389.707	812.616	7.402	0.007
94	+	NA	+	+	+	NA	+	12	-394.247	812.738	7.523	0.006
124	+	+	NA	+	+	+	+	16	-389.812	812.826	7.611	0.006
14	NA	+	+	+	NA	NA	NA	11	-395.489	814.026	7.811	0.005
27	NA	+	NA	+	+	NA	NA	11	-395.588	814.224	8.010	0.005

58	+	NA	NA	+	+	+	NA	9	-397.782	814.273	8.059	0.005
57	NA	NA	NA	+	+	+	NA	8	-398.860	814.285	8.070	0.005
28	+	+	NA	+	+	NA	NA	12	-394.802	814.847	8.633	0.004
44	+	+	NA	+	NA	+	NA	12	-394.926	814.095	8.880	0.003
121	NA	NA	NA	+	+	+	+	11	-396.212	814.474	9.260	0.003
16	+	+	+	+	NA	NA	NA	12	-395.217	814.677	9.462	0.002
122	+	NA	NA	+	+	+	+	12	-395.318	814.880	9.665	0.002
111	NA	+	+	+	NA	+	+	14	-391.978	814.891	9.676	0.002
91	NA	+	NA	+	+	NA	+	14	-393.225	816.127	9.922	0.002
79	NA	+	+	+	NA	NA	+	14	-393.544	816.776	10.561	0.001
26	+	NA	NA	+	+	NA	NA	8	-400.112	816.791	10.576	0.001
25	NA	NA	NA	+	+	NA	NA	7	-401.207	816.851	10.637	0.001
11	NA	+	NA	+	NA	NA	NA	10	-398.178	817.226	11.012	0.001
92	+	+	NA	+	+	NA	+	14	-392.797	817.529	11.314	0.001
89	NA	NA	NA	+	+	NA	+	10	-398.487	817.844	11.629	0.001
112	+	+	+	+	NA	+	+	16	-391.895	817.993	11.779	0.001
107	NA	+	NA	+	NA	+	+	14	-394.358	818.403	12.188	0.001
90	+	NA	NA	+	+	NA	+	11	-397.752	818.551	12.336	0.001
45	NA	NA	+	+	NA	+	NA	8	-401.068	818.700	12.486	0.001
12	NA	NA	+	+	NA	NA	NA	7	-402.212	818.861	12.646	0.000
80	+	+	+	+	NA	NA	+	14	-393.493	818.922	12.707	0.000
12	+	+	NA	+	NA	NA	NA	11	-397.938	818.924	12.709	0.000
46	+	NA	+	+	NA	+	NA	9	-400.634	819.977	12.762	0.000
14	+	NA	+	+	NA	NA	NA	8	-401.724	820.012	12.798	0.000
109	NA	NA	+	+	NA	+	+	11	-398.566	820.180	12.966	0.000
117	NA	NA	+	NA	+	+	+	9	-400.832	820.372	14.148	0.000
77	NA	NA	+	+	NA	NA	+	10	-399.770	820.409	14.194	0.000
75	NA	+	NA	+	NA	NA	+	12	-396.486	820.428	14.214	0.000
108	+	+	NA	+	NA	+	+	14	-394.263	820.462	14.247	0.000
41	NA	NA	NA	+	NA	+	NA	7	-403.338	821.112	14.899	0.000

118	+	NA	+	NA	+	+	+	10	-400.245	821.360	14.146	0.000
85	NA	NA	+	NA	+	NA	+	8	-402.552	821.669	14.454	0.000
110	+	NA	+	+	NA	+	+	12	-398.250	821.744	14.529	0.000
112	NA	NA	NA	NA	+	+	+	8	-402.660	821.885	14.671	0.000
78	+	NA	+	+	NA	NA	+	11	-399.497	822.042	14.828	0.000
9	NA	NA	NA	+	NA	NA	NA	6	-404.980	822.288	16.073	0.000
76	+	+	NA	+	NA	NA	+	14	-396.427	822.540	16.325	0.000
42	+	NA	NA	+	NA	+	NA	8	-402.999	822.563	16.348	0.000
105	NA	NA	NA	+	NA	+	+	10	-400.871	822.611	16.396	0.000
86	+	NA	+	NA	+	NA	+	9	-402.059	822.827	16.612	0.000
114	+	NA	NA	NA	+	+	+	9	-402.122	822.953	16.738	0.000
119	NA	+	+	NA	+	+	+	12	-398.019	823.493	17.279	0.000
10	+	NA	NA	+	NA	NA	NA	7	-404.586	823.610	17.395	0.000
73	NA	NA	NA	+	NA	NA	+	9	-402.712	824.124	17.920	0.000
106	+	NA	NA	+	NA	+	+	11	-400.597	824.241	18.027	0.000
54	+	NA	+	NA	+	+	NA	7	-404.958	824.353	18.129	0.000
53	NA	NA	+	NA	+	+	NA	6	-406.048	824.422	18.208	0.000
114	NA	+	NA	NA	+	+	+	12	-399.610	824.463	18.248	0.000
81	NA	NA	NA	NA	+	NA	+	7	-405.077	824.592	18.377	0.000
120	+	+	+	NA	+	+	+	14	-397.622	824.930	18.714	0.000
49	NA	NA	NA	NA	+	+	NA	5	-407.645	825.522	19.307	0.000
50	+	NA	NA	NA	+	+	NA	6	-406.690	825.706	19.491	0.000
116	+	+	NA	NA	+	+	+	12	-399.172	825.800	19.585	0.000
82	+	NA	NA	NA	+	NA	+	8	-404.634	825.834	19.619	0.000
74	+	NA	NA	+	NA	NA	+	10	-402.483	825.836	19.622	0.000
87	NA	+	+	NA	+	NA	+	12	-400.387	826.018	19.803	0.000
88	+	+	+	NA	+	NA	+	12	-400.124	827.705	21.490	0.000
55	NA	+	+	NA	+	+	NA	10	-403.498	827.866	21.652	0.000
56	+	+	+	NA	+	+	NA	11	-402.538	828.124	21.909	0.000
51	NA	+	NA	NA	+	+	NA	9	-404.750	828.209	21.994	0.000

83	NA	+	NA	NA	+	NA	+	11	-402.703	828.453	22.238	0.000
52	+	+	NA	NA	+	+	NA	10	-403.814	828.497	22.283	0.000
22	+	NA	+	NA	+	NA	NA	6	-408.559	829.445	23.230	0.000
21	NA	NA	+	NA	+	NA	NA	5	-409.794	829.820	23.606	0.000
84	+	+	NA	NA	+	NA	+	12	-402.417	830.077	23.862	0.000
101	NA	NA	+	NA	NA	+	+	8	-407.418	831.401	25.187	0.000
97	NA	NA	NA	NA	NA	+	+	7	-408.686	831.809	25.594	0.000
69	NA	NA	+	NA	NA	NA	+	7	-408.812	832.062	25.848	0.000
18	+	NA	NA	NA	+	NA	NA	5	-410.970	832.173	25.959	0.000
17	NA	NA	NA	NA	+	NA	NA	4	-412.044	832.242	26.028	0.000
37	NA	NA	+	NA	NA	+	NA	5	-411.425	833.083	26.868	0.000
33	NA	NA	NA	NA	NA	+	NA	4	-412.595	833.344	27.120	0.000
102	+	NA	+	NA	NA	+	+	9	-407.327	833.362	27.147	0.000
65	NA	NA	NA	NA	NA	NA	+	6	-410.667	833.661	27.446	0.000
98	+	NA	NA	NA	NA	+	+	8	-408.603	833.771	27.557	0.000
70	+	NA	+	NA	NA	NA	+	8	-408.742	834.048	27.833	0.000
103	NA	+	+	NA	NA	+	+	12	-404.485	834.214	27.999	0.000
99	NA	+	NA	NA	NA	+	+	11	-405.722	834.491	28.276	0.000
38	+	NA	+	NA	NA	+	NA	6	-411.124	834.595	28.380	0.000
34	+	NA	NA	NA	NA	+	NA	5	-412.350	834.932	28.718	0.000
71	NA	+	+	NA	NA	NA	+	11	-406.238	835.523	29.308	0.000
66	+	NA	NA	NA	NA	NA	+	7	-410.605	835.648	29.433	0.000
35	NA	+	NA	NA	NA	+	NA	8	-409.548	835.660	29.445	0.000
39	NA	+	+	NA	NA	+	NA	9	-408.557	835.823	29.608	0.000
23	NA	+	+	NA	+	NA	NA	9	-408.638	835.984	29.769	0.000
24	+	+	+	NA	+	NA	NA	10	-407.642	836.143	29.938	0.000
104	+	+	+	NA	NA	+	+	12	-404.481	836.417	30.203	0.000
100	+	+	NA	NA	NA	+	+	12	-405.712	836.669	30.454	0.000
5	NA	NA	+	NA	NA	NA	NA	4	-414.263	836.680	30.465	0.000
67	NA	+	NA	NA	NA	NA	+	10	-408.090	837.050	30.836	0.000

36	+	+	NA	NA	NA	+	NA	9	-409.391	837.490	31.275	0.000
40	+	+	+	NA	NA	+	NA	10	-408.391	837.651	31.436	0.000
72	+	+	+	NA	NA	NA	+	12	-406.237	837.718	31.503	0.000
19	NA	+	NA	NA	+	NA	NA	8	-410.602	837.769	31.555	0.000
6	+	NA	+	NA	NA	NA	NA	5	-412.858	837.948	31.733	0.000
20	+	+	NA	NA	+	NA	NA	9	-409.667	838.043	31.829	0.000
1	NA	NA	NA	NA	NA	NA	NA	3	-414.989	838.070	31.855	0.000
68	+	+	NA	NA	NA	NA	+	11	-408.089	839.226	33.011	0.000
2	+	NA	NA	NA	NA	NA	NA	4	-414.641	839.436	33.221	0.000
7	NA	+	+	NA	NA	NA	NA	8	-412.555	841.674	35.460	0.000
3	NA	+	NA	NA	NA	NA	NA	7	-414.179	842.795	36.580	0.000
8	+	+	+	NA	NA	NA	NA	9	-412.303	843.314	37.100	0.000
4	+	+	NA	NA	NA	NA	NA	8	-412.945	844.454	38.240	0.000

Annex VII – Models explaining factors influence on Hunters *fear* towards wolves

	Knowledge of Attack	*School Level*	*Gender*	*Knowledge Index*	*Population Size*	*Age*	*df*	*logLik*	*AICc*	*ΔAICc*	*Akaike Weight*
27	NA	+	NA	+	+	NA	10	-100.408	224.424	0.000	0.176
28	+	+	NA	+	+	NA	11	-99.269	224.938	0.514	0.126
20	+	+	NA	NA	+	NA	8	-103.477	225.239	0.816	0.117
24	+	+	+	NA	+	NA	9	-102.343	225.589	1.166	0.098
31	NA	+	+	+	+	NA	11	-99.929	226.257	1.834	0.070
32	+	+	+	+	+	NA	12	-98.610	226.507	2.084	0.062
19	NA	+	NA	NA	+	NA	7	-105.436	226.622	2.199	0.058
18	+	NA	NA	NA	+	NA	5	-108.314	227.538	3.114	0.037
23	NA	+	+	NA	+	NA	8	-104.760	227.805	3.381	0.032
17	NA	NA	NA	NA	+	NA	4	-109.903	228.403	3.980	0.024
25	NA	NA	NA	+	+	NA	7	-106.361	228.473	4.049	0.023
56	+	+	+	NA	+	+	12	-99.883	229.054	4.631	0.017
55	NA	+	+	NA	+	+	11	-101.438	229.277	4.853	0.016
22	+	NA	+	NA	+	NA	6	-108.096	229.484	5.060	0.014
26	+	NA	NA	+	+	NA	8	-105.712	229.711	5.288	0.012
51	NA	+	NA	NA	+	+	10	-103.181	229.969	5.545	0.011
8	+	+	+	NA	NA	NA	8	-105.962	230.210	5.786	0.010
29	NA	NA	+	+	+	NA	8	-105.995	230.276	5.853	0.009
52	+	+	NA	NA	+	+	11	-102.007	230.414	5.991	0.009
4	+	+	NA	NA	NA	NA	7	-107.372	230.493	6.070	0.008
21	NA	NA	+	NA	+	NA	5	-109.834	230.578	6.144	0.008
59	NA	+	NA	+	+	+	12	-99.241	230.758	6.334	0.007
63	NA	+	+	+	+	+	14	-97.969	231.307	6.884	0.006
30	+	NA	+	+	+	NA	9	-105.277	231.458	7.035	0.005

3	NA	+	NA	NA	NA	NA	6	-109.426	232.144	7.720	0.004
60	+	+	NA	+	+	+	14	-98.442	232.253	7.830	0.004
64	+	+	+	+	+	+	14	-97.033	232.638	8.214	0.003
49	NA	NA	NA	NA	+	+	7	-108.537	232.824	8.400	0.003
7	NA	+	+	NA	NA	NA	7	-108.566	232.883	8.459	0.003
50	+	NA	NA	NA	+	+	8	-107.307	232.900	8.477	0.003
12	+	+	NA	+	NA	NA	10	-105.097	233.800	9.376	0.002
2	+	NA	NA	NA	NA	NA	4	-112.617	233.832	9.408	0.002
11	NA	+	NA	+	NA	NA	9	-106.579	234.062	9.639	0.001
40	+	+	+	NA	NA	+	11	-104.027	234.455	10.031	0.001
54	+	NA	+	NA	+	+	9	-106.882	234.666	10.243	0.001
57	NA	NA	NA	+	+	+	10	-105.574	234.754	10.331	0.001
53	NA	NA	+	NA	+	+	8	-108.272	234.829	10.406	0.001
1	NA	NA	NA	NA	NA	NA	3	-114.246	234.845	10.422	0.001
16	+	+	+	+	NA	NA	11	-104.345	235.090	10.667	0.001
36	+	+	NA	NA	NA	+	10	-105.967	235.540	11.117	0.001
6	+	NA	+	NA	NA	NA	5	-112.340	235.588	11.165	0.001
14	NA	+	+	+	NA	NA	10	-106.004	235.614	11.191	0.001
39	NA	+	+	NA	NA	+	10	-106.142	235.911	11.487	0.001
35	NA	+	NA	NA	NA	+	9	-107.703	236.309	11.886	0.000
58	+	NA	NA	+	+	+	11	-104.959	236.318	11.895	0.000
61	NA	NA	+	+	+	+	11	-105.067	236.533	12.110	0.000
5	NA	NA	+	NA	NA	NA	4	-114.144	236.904	12.481	0.000
62	+	NA	+	+	+	+	12	-104.431	238.140	12.727	0.000
9	NA	NA	NA	+	NA	NA	6	-112.626	238.545	14.122	0.000
10	+	NA	NA	+	NA	NA	7	-111.514	238.780	14.357	0.000
34	+	NA	NA	NA	NA	+	7	-111.784	239.318	14.895	0.000
43	NA	+	NA	+	NA	+	12	-105.177	239.643	14.219	0.000
33	NA	NA	NA	NA	NA	+	6	-112.232	239.756	14.333	0.000
44	+	+	NA	+	NA	+	12	-103.816	239.908	14.485	0.000

47	NA	+	+	+	NA	+	12	-104.078	240.432	16.009	0.000
48	+	+	+	+	NA	+	14	-102.603	240.575	16.141	0.000
12	NA	NA	+	+	NA	NA	7	-112.414	240.581	16.147	0.000
14	+	NA	+	+	NA	NA	8	-111.236	240.757	16.333	0.000
38	+	NA	+	NA	NA	+	8	-111.432	241.140	16.726	0.000
37	NA	NA	+	NA	NA	+	7	-112.038	241.826	17.402	0.000
41	NA	NA	NA	+	NA	+	9	-111.763	244.429	20.006	0.000
42	+	NA	NA	+	NA	+	10	-110.619	244.844	20.420	0.000
45	NA	NA	+	+	NA	+	10	-111.555	246.717	22.293	0.000
46	+	NA	+	+	NA	+	11	-110.396	247.192	22.769	0.000