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OBSERVATIONS ON ROARING ACTIVITY OF MESOLA RED DEER DURING THE 2013 SEASON

OSSERVAZIONI SULL'ATTIVITÀ DI BRAMITO DEL CERVO DELLA MESOLA NELLA STAGIONE 2013

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SUMMARY

Gran Bosco della Mesola is a renowned natural reserve situated on the southern part of the Po delta and its importance is due for being one of the last witnesses of the ancient forest covering the Padan plain and for hosting the last population of Italian red deer. This work is concerning exactly about this animal and particularly on its rutting season, describing the trend of this period running from half of September to end of October. In the last years researchers have been focusing more and more to figure out if this relict nucleus represents a distinct subspecies of the red deer (*Cervus elaphus*) since it was observed that biometrics measures and genetic remarks differ from other European populations. The analysis of the roaring activity has been carried out through alternative methods; traditional censuses in loco consisting in writing down manually every roar heard for every deer took place in the northern part of Elciola meadow in the center of the reserve while the other method involved the use of digital recorders correctly scheduled to record from 17:00 to 23:00 every day from the 17th September to the 3th November.

The purpose is to find out the peak of the roaring activity and others related parameters through both methods: the roaring peak was identified on the 3th October for both paper and digital data, respectively 1724 and 817 roars. In data analysis and discussion it has been estimated that the hour before and the one after the Astronomical Sunset have respectively 21% and 19% of the total roars counted on recordings. The census on the spot brought to a quite faithful value of the number of active deer, estimated on a maximum of nine specimens. Furthermore a comparison concerning digital data has been carried out about the roaring analysis confronting the number of roars obtained listening the chosen intervals and by counting roars spectra on recording's spectrogram resulting in similar conclusions.

RIASSUNTO

Gran Bosco della Mesola è una riserva naturale situata nella parte meridionale del delta del Po e la sua importanza è dovuta essenzialmente a due aspetti: da un lato essa rappresenta una delle ultime testimonianze dell'antica foresta decidua che ricopriva una volta la pianura Padana mentre dall'altro lato la sua rilevanza è dovuta alla presenza del cervo, la cui popolazione della riserva è considerata l'ultimo relitto del cervo della penisola italiana. Questo lavoro ha l'obiettivo di descrivere l'andamento della stagione degli amori che circa va da metà settembre fino a fine ottobre. Studiosi e ricercatori negli ultimi anni stanno cercando di capire se questa peculiare entità faunistica effettivamente rappresenta una distinta sottospecie del cervo nobile dato che sono state osservate misure biometriche differenti e singolarità genetiche rispetto ad altre popolazioni. L'analisi della stagione di bramito è stata condotta seguendo due metodi alternativi: il primo prevedeva il tradizionale censimento cartaceo eseguito registrando manualmente ogni bramito ascoltato e il suo rispettivo cervo mentre il secondo consisteva nella registrazione digitale tramite registratori programmati per funzionare ogni giorno dalle 17 alle 23 per l'intero periodo dal 17 settembre al 3 novembre. Entrambi i rilievi sono stati fatti nella parte settentrionale del recinto "Elciola". Nell'analisi dei risultati sono stati individuati alcuni parametri e valori importanti nel descrivere l'andamento della stagione tra cui il picco di attività registrato in occasione del 3 ottobre sia nelle schede cartacee sia analizzando i dati digitali, rispettivamente 1724 e 817 bramiti. Altri parametri stimati sono ad esempio il conteggio dei bramiti nell'ora antecedente e quella seguente al Tramonto Astronomico (TA) , risultando rispettivamente 21% e 19% del totale. Il rilievo cartaceo ha permesso di effettuare una stima dei cervi attivi di cui ne sono stati individuati nove. Nell'ambito del confronto di efficienza tra metodi nell'analisi dei dati digitali è stata comparata la conta dei bramiti tramite l'ascolto e tramite il conteggio degli spettri relativi alle vocalizzazioni per ogni spettrogramma giornaliero. Il risultato ottenuto si è rivelato piuttosto soddisfacente con differenze lievi nel conteggio risultando perciò due buone alternative per un'analisi del bramito.

INTRODUCTION

This work aims to carry on a group of studies concerning the red deer inhabiting the Natural Reserve “Gran Bosco della Mesola” focusing on the mating and rutting season. This wooden land stretches for approximately 1060ha on the southern Po delta area, in the district of Ferrara and represents a very significant naturalistic site since is one of the last remnants of the ancient deciduous forest that was covering the Padan plain. Furthermore the red deer population of the reserve can be considered the last specimens remained of the original Italian peninsula deer; the isolation of this nucleus avoided the crossbreed with other subspecies maintaining the genetic purity of this population. Subsequently the framework of this Mesola red deer will be deeply analyzed focusing on its own peculiar characteristics compared to other deer populations and on its uses and activities related to other environmental factors such reproductive isolation, lack of resources and trophic competition. There would be many aspects of this deer to dwell on but this study is addressed to the breeding season running from September to end of October; the practical work behind the scenes involved traditional censuses on the spot around the astronomical sunset and 6-hours recordings for each day through recorders: the comparison between paper and digital data so achieved is the basis of the analysis of the trend of the roaring activity. On a broader scale these data with others collected until now aim to contribute in a deeper knowledge about this peculiar wildlife unit.

1 THE RED DEER

1.1 Taxonomy

KINGDOM: Animalia

PHYLUM: Chordata

CLASS: Mammalia

ORDER: Artiodactyla

SUBORDER: Ruminantia

FAMILY: Cervidae

SUBFAMILY: Cervinae

GENUS: *Cervus* (Linnaeus, 1758)

SPECIES: *Cervus elaphus* (Linnaeus, 1758)

1.2 Distribution

The red deer has a wide and large distribution area throughout the northern hemisphere and it can be found in several environments thanks to its great ability to cope with environmental changes. The range includes three continents such as Africa, Europe and Asia but the species has been introduced also in other regions around the world; recently researches showed up that the deer inhabiting North America is genetically different belonging then to another species, the wapiti (*C. canadensis*). In Africa it can be found in the North Sahara countries of Tunisia and Algeria whereas in Asia the species extends from Middle East to the extreme eastern Russian territory. In Europe the red deer colonized mostly the whole continent exception made for the northern part of the Scandinavian peninsula and Russia where it is substituted by other deer species like the moose and the reindeer. In Italy red deer can be found homogeneously on the Alps up to the wood limit especially in summer while during the winter months it roams the valleys at lower altitudes; its presence is more discontinuous across the Apennine Mountains until the Pollino National Park where it

has been newly introduced and that represent the lowest point in the Italian peninsula where the species is present. The distribution of the red deer in the past was including also the Padan Plain but the hunting pressure and the urbanization pushed the animal towards the mountains. In Sardinia very relevant is the subspecies of the Sardinian deer (*C. e. corsicanus*) that has been declared as a protected species. All across Europe many populations has been combined with different subspecies resulting in genetic changes in deer so that now biologists are arranging DNA tests to identify the specimens belonging to the original European population in order to eventually operate for their benefit.

Picture 1.2: Distribution of *C.elaphus*
(picture from "The IUCN Red List of Threatened Species").

1.2.1 Habitat and Ecology

The red deer occupies a wide range of habitats, from the moors and peat-lands of Scotland to coastal Mediterranean forests; the mountainous regions are not the natural habitat for the red deer since it is typically a low altitude species but deforestation along urbanization and hunting activity pushed the populations at higher altitudes; here they show a marked preference for open deciduous woodlands avoiding dense formations because they need meadows and pastures for different activities. In summer they can be found over the tree line while in winter they come down in valleys looking for more suitable sources of food. The red deer is a ruminant

and its diet consists mainly of shrubs and tree shoots when in forests, but in other habitats it may change including a wider variety of grasses, also fodder when they come closer to human settlements. In many areas the trophic activity of red deer can result in damages for the ecosystem and human activities: damages for rubbing against the bark of trees occur in losses in timber value while the constant and huge stripping of shoots influences strongly the forest cover and renovation.

1.3 Morphology

European red deer is the biggest species belonging to Cervidae family of Italian wildlife landscape. Its elegant aspects is the reason of the nickname “king of the forest”. There is a marked sexual dimorphism between males and females that will be deeply analyzed in the following paragraphs but differences can be observed also between different specimens due to the introduction of different subspecies (*C. e. canadensis*) in the same area of the European red deer or even different species (*C. nippon*); beside the genetic combination, the adaptation to different environments related to different trophic substrates influenced the phenotype, the structure and the size.

1.3.1 The stag

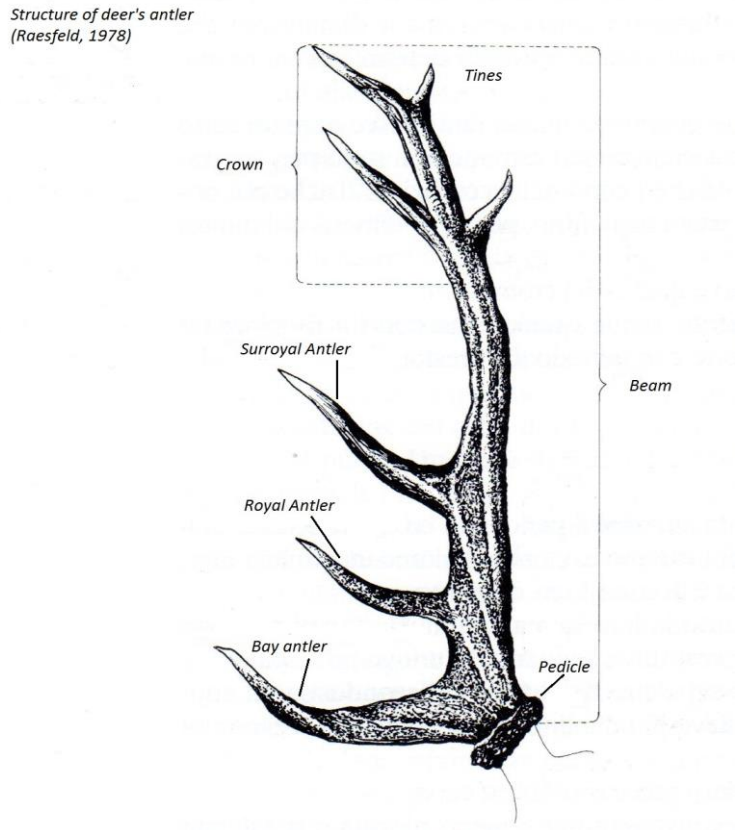
The male of the red deer is also known as stag and it can weigh up to 250 kg but the average weight for an European stag is around 160-180 kg; specimens of Mediterranean Europe are smaller cause adapted to live in a poor-resource environment (*C. elaphus corsicanus*) while some populations living in the eastern part of the continent can result even bigger than the normal standards. Stag’s length from sternum to coccyx ranges between 180 cm- 220 cm and the height at the withers hardly overcome 140 cm, on an average value of 120 cm. Specimens increase in size until the age of 7-8 years followed by a gradual physical decline culminating in death that occurs rarely after 15 years in wild populations. The summer coat it’s reddish-brown and the anal area is less evident than in the winter coat where reddish is substituted by grey; the last one is characterized by a thicker dewlap, present only on

male's throats, and by a grey color that is brighter on sides and back than other parts.

The most peculiar feature of the stag is the presence of antlers that fall down every winter to grow up newly in late spring. The formation of this antlers are due to the effect of the hormone testosterone; they stand on two bony outgrowths of the skull and firstly they are covered by a soft velvet that fell down when mature in late summer. Antlers first appear around one year of life. They can stretch until 100cm and they are composed by a variable number of tines, depending on age and subspecies: the part touching the skull is called *pedicle*, the main axe were tines stand out is called *beam*; from the base to the top the tines are *bay antler, royal antler, surroyal antler* and on the top a crown composed by 2 tines (*fork*) or more (*palm*). The belief that the number of tines reveals the age of the specimen is wrong but it's possible to figure out approximately the age class. The stag presents different stages in life that can be summarized and identified as following:

Fawns	0 – 1 y	The newborns stay hidden in the grass for the first weeks before being ready to join the herd. At birth weight is 7-10 kg but at the end of the first year increases of 50 %.
Young deer	1 – 3 y	They have size comparable to hinds (females) and antlers have only the beam that in oldest is lightly bent eventually dotted with drafts of tines.
Sub-adults	4 – 5 y	The size is now similar to adults but muscles are evidently less tonic. Antlers have almost all tines but it is smaller. The mane starts to grow during the rut and neck muscles begin to thicken.
Adults	5 – 9 y	At the top of power and strength, the mane is completely developed along with antlers that present all the tines and the biggest size. The neck is obviously bigger and the weight is all shifted to the front.
Old deer	>10 y	Lifespan for deer is around 15 years in wild habitats. Old specimens show a decline in antlers formation along with

		muscles vigor and a lower neck posture. They tend to stay alone in forest, less visible than others specimens.



Picture 1.3.1: The structure of a red deer's antler

1.3.2 The female

Females are clearly smaller in size compared to stags: weight increases until approximately 3-4 years when it stops around 80 kg, height at the shoulder is 90 -110 cm and the sternum-coccygeal length is 150-190 cm. Many differences can be observed between females of different ages, belonging to different life-stages: youngers before breeding are thinner and the belly is reentrant while adult females are characterized by stronger body and a different shape of the belly, not falling but more parallel to the ground. The oldest females show an evident decay in fitness with a falling neck and less tonic muscles.

1.3.3 Fawns

Newborns weigh at birth 7 – 10 kg and the main characteristic beside the small size is the mottle coat that last for three months It helps the fawn to camouflage into the undergrowth against predators since hinds for first weeks are leaving them alone for most of the day.

1.4 Behaviour and Population dynamics

Red deer is a gregarious species that shows different trends and behaviours related to many aspects, such part of the year considered, density of population, birth rate and mortality factors. Typically the family units are composed by the adult female, the newborn and the fawn born the previous year. These units are generally gathered in bigger groups reaching up to 50 elements without compromising the basic nucleus. The birth rate, in good environmental conditions, can involve until 65-70 % of the females along a youth mortality rate that is higher in winter but that stays under 10%. The density of a population of red deer ranges from 1 to 8-10 elements for 100ha but these data may vary depending on different seasons: indeed during the breeding season it can rise up to 20 elements for 100ha. The vital spaces for a population broaden from 100 ha to 10000 ha depending on environmental conditions and population uses but generally the area where individuals preferably operate is around 45 – 50 ha.

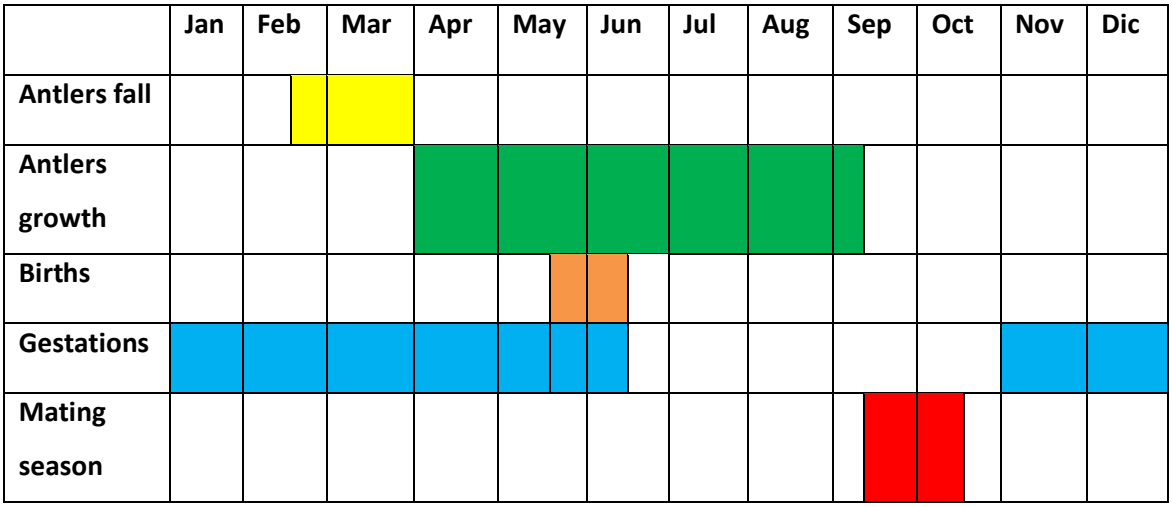
Stag's behaviour

Stags behaviour can be quite easily outlined throughout the year and the different uses and activities. During the mating season they separate from other stags and the social mature individuals form a harem of females that they will protect from other males. This season that runs from September to half October shows the reformation of the hierarchy through the vocalizations that are necessary to stave off other stags and to attract females. The places chosen for this "vocal battles" are usually open places where subsequently occur the mating act; after this stags leave the females and constitute small groups and they will spend the winter together until the loss of antlers

happening from end of February to end of March that lead to a new separation of the group. From April the new antlers will start to grow again and new hierarchies will be brought up in the herd that will last until the new breeding season.

Hind's behaviour

Females are more linear in their uses and behavior compared to males. They tend to keep one three-elements family but spend long part of the year altogether with other families. During the mating seasons they are gathered from males to form harems and they will be protected by them against other competitors; After breeding they are left by the stag and they will spend the winter in big groups until the end of gestations period that occurs at the end of May. Until half June pregnant hinds will separate to give birth to a newborn. Herds are reconstituted from June to September. Fawns stay hidden for the first weeks in the undergrowth until when they are judged mature enough to follow nocturnal shifts of mothers. The weaning occurs around six months of age.



Tab.1: scheme of the distribution of red deer's activities during one year.

1.5 The red deer's roar

This peculiar phenomenon consists in a vocalization emitted by the stags during the mating period that runs from half September to half-end of October. Stags through

these vocalizations want to achieve two different purposes at the same time: on one side they want to attract the females and to keep the most of them while on the other side the roar is a signal of competition with other stags. The deer showing the most powerful vocalization are supposed to keep distant other rivals but are not absent the situations where two stags are not coming to a final result since they might have the same powerful roar. Then ,besides roaring, they start to make specific movements forward and back to intimidate the opposite stag. These phenomena develop in open places and meadows called “arenas” out from forests where stags can more easily gather hinds. The roaring peak occur during the hours around the sunset. There is also a physiological explanation to the emission of vocalization. When the photoperiod changes from September, the pineal gland is stimulated to the secretion of an hormone, the melatonin. This hormone is directly connected to the secretion of testosterone so that an increase of melatonin runs along with an increase in testosterone’s concentration leading to the starting of the mating season. All period long stags are separated from other stags and from herd mates, becoming rivals. The intensification of activities during the roaring period consists in a huge effort for males and they can lose up to 30% of their weight. At the end of the breeding new hierarchies will form and stags will retire in the forest.

Picture 1.5: A Mesola Red Deer roaring (Quaderni di Conservazioni della Natura,36).

2 GRAN BOSCO DELLA MESOLA

2.1 Historical background

Gran Bosco della Mesola is a renowned natural reserve located on the south part of the Po delta, an area belonging to the district of Ferrara. The first aspect and most relevant of this reserve is the presence of the red deer, which population represents the last one of Italian peninsula that has kept its genetic authenticity and that hasn't come in contact with other different populations. But before introducing better this animal, which analysis will be the main topic of this work, it's appropriate to describe the Natural Reserve where it can be found and few others characteristics that make this place very interesting and worthy to discover. Between the 1578 and 1583 on the orders of the Duke Alfonso II d'Este a castle was built in Mesola ,surrounding it with around 5000 ha of wood, where he could spend the time on hunting deer; in the following centuries the wood has been subject to reductions that culminated in the actual surface of approximately 1060ha. It is the only spot left after centuries of reclamation and deforestation. Throughout centuries the forest maintained a condition of isolation from the rest of the plain, guaranteeing partial protection to the biodiversity of the place. Nevertheless the Gran Bosco underwent different ownerships, from Austrians (1758 – 1784), through Papal State (until 1814) to the Istituto dello Spirito Santo of Rome. Subsequently it was purchased by Società delle Bonifiche Ferraresi which was utilizing it for hunting purposes until the II World War. Finally in the 1954 the Natural Reserve was bought from the State Forestry Services avoiding a possible disaster due to exaggerated logging and animal kills. In 1977 the reserve has been declared "National Reserve of the State". Still now the Services are undertaking constant actions to allow the protection and the valorization of the forest and its essential components.

Picture 2.1: View of the Natural Reserve from the air (Photo Scanavini A.).

2.2 Geographic and naturalistic aspects: framework of the station

2.2.1 Geography

Gran Bosco della Mesola stretchs on 1058 ha of surface and it is surrounded for the whole perimeter by a fence of around 21km that separate it from fields, exception made for the southern part that it's touched by the Adriatic Sea and the mouth of Po di Volano, the southernmost branch of the delta. It's already been said that the wood is included in the district of Ferrara but considering a smaller scale, it is split between three municipalities, Goro, Codigoro and Mesola; it stands between -1 and 3m on the sea level and its geographic coordinates are 44.50 N for latitude and 12.15 E for longitude. The territory has been dotted with forestry roads and irrigation canals; furthermore to organize best the distribution of ungulates and address the touristic flows, different concentric fences have been arranged, which central one is the field of "Elciola".

Picture 2.2.1: Forest road running in Elciola (Photo Baratelli, 2013).

2.2.2 Pedology and hydrology

Gran Bosco della Mesola lies on a soil formation ,that involves the whole delta, established during the Quaternary Period. Analysis reveal that the prevalent component of the soil is sand, while loam and clay together reach up only 1.5 % of the total; this combination is typically responding to a poorly evolved and uniform soil. The presence of limestone can be classified in an average range of values while the soil reaction is typically neutral-alkaline due to the marine chlorides but where lot of organic material decomposes on the ground can occur sub-acid reactions as well. The Oxidation process of organic matter is generally rapid but can happens that in less exposed places it is slowed down. After being rescued by the National Forest Services, many works and improvements have been carried out on the surface of the reserve, especially the arrangement of an efficient net of canals playing a fundamental ecological function. The water flow is conveyed to the internal channels net through a system of locks from an external source, the Canal Bianco. In 1978 in Elciola, where big part of animals community usually gathers, an artificial water basin (7 ha) was created to offer an ever present source of refreshment and watering throughout the seasons

to animals. When the phreatic zone cannot fulfill enough to this task, like in the driest months, water is conveyed in alternative ways.

2.2.3 Climate

The climate should tend to a continental type but the closeness to the sea causes a mitigation of temperatures. Summer on the delta presents high average temperatures around 26-27 °C but that can grow up to 30°C while winter average temperatures never go down under the 0, a value that is not reached often anyway. The rainfalls pattern shows two highest peaks corresponding to April and November while the lowest peak is reached in February.

2.2.4 Flora and Fauna

Due to the massive deforestation actions occurred in the past, the natural reserve constitutes one of the last forest formations left on the Padan plain. This forest is a complex ecosystem that can be considered as generally poor of resources environment ,as the sandy consistence of the soil may suggests, but this doesn't allow to think that the reserve presents lack of relevant wildlife and floristic biodiversity.

Flora

The forest formation is classified as *thermophile* and can be split in two different components, one typically *xerophile* and one more *hygrophile*. The first includes those areas nearby the coast just next to the dunes or where the soil is dry. The most important species that can be found here beside the herbaceous plants growing on the dunes are: the Common Juniper (*Juniperus communis*), the Butcher's Broom (*Ruscus aculeatus*), the Salvia Cistus (*Cistus salvifolius*) and tree species as Domestic Pine (*Pinus pinea*), the most widespread species of Pinaceae family here even if also Maritime Pine(*Pinus pinaster*) and Black Pine(*Pinus nigra*) can be found. Important is also the presence of *Carpinus orientalis* that reaches here the highest latitude on Italian coasts. Before getting into the real hygrophile formations there is a transition step that is made up by the most relevant tree species, the Holm Oak (*Quercus ilex*), belonging to the oak genus and that presents an intermediate behavior, not really xerophyte but not even too much humidity tolerant. The Holm Oak is not only the most widespread

plant of the natural reserve but its formation here is one of the last samples left in northern Italy. Due to the swampy terrain typical of the delta of a river, species such the *Quercus robur* made its home here but its diffusion is limited because the proximity to the sea. Other important species to be mentioned are ashes (gen. *Fraxinus*) that are xerophile and aspens (gen. *Populus*) that can be found in meadows and open fields for being not shadow tolerant.

Fauna

Animal communities here play an important role and their interactions have always been the center of management of the reserve, at least for few of them. Gran Bosco della Mesola is a closed area which fence doesn't allow many species to come in contact with the outside nature, the case for example of the red deer that adapted to live in this poor environment. The other ungulate living here is the fallow deer (*Dama dama*). Beside these two biggest in size animals can be counted other species belonging to the class of Mammals like hedgehogs (Erinaceus europaeus), the fox (Vulpes vulpes) that has been reintroduced recently in 70s, weasel (Mustela nivalis), the mink (Meles meles), the hare (Lepus timidus) and few rodent such the dormouse (Glis glis).

But the animal class better represented are undoubtedly birds. It was estimated that more than 140 species of birds were sighted in the park, including migrators and exceptional visitors but up to 60 species make their nest here. The most outstanding are herons (gen. *Ardea* and *Egretta*), ducks (fam. *Anatidae*), buzzards (*Buteo buteo*) and pheasants (*Phasianus colchicus*).

3 MESOLA RED DEER

3.1 History and origin of Mesola red deer

The population of deer that roams the Natural reserve is the last witness of the Italian peninsula's red deer that hasn't come in contact with European individuals. While deforestation and urbanization were pushing deer's population towards mountain areas, Gran Bosco della Mesola represented a sanctuary for those living inside the fence of the wood: a big hydraulic operation in 1604 consisting in the deviation of a Po branch caused the isolation of the wooden land, almost completely surrounded by malarial swamps. Nevertheless the population went through hard moments even risking the extinction in several times due to wrong managements, high hunting pressures, poaching and logging.

In 1911 A. Ghigi , a famous Italian zoologist, undertook an analysis focused on Italian mammals and he showed the results during an International Hunting Convention in Wien, giving attention also to this deer's population of Gran Bosco della Mesola. He was the first to point out the relevance of this nucleus and its autochthony. After the II World War these deer were close to disappear until the taking of the wooden land by the National Forestry Services; from that moment different many operations and researches have been carried out to protect, maintain and develop this population.

The aim of the researches concerning the Mesola red deer is to give an international official recognition to this nucleus and to identify it as a subspecies of *Cervus elaphus* so that they can benefit of all those measures deriving from this nomination, like in the case of the Sardinian red deer (*Cervus elaphus corsicanus*).

3.2 Morphology

The phenotype of this specimens is the first thing that appears different in these deer. They present reduced dimensions compared to European populations, that can be observed in various aspects.

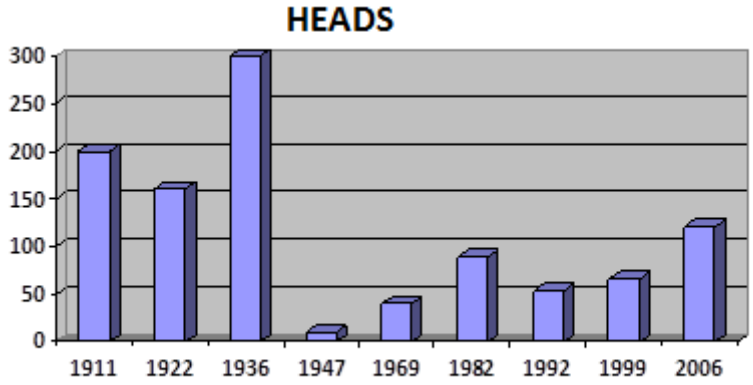
The average weight of stags and hinds is around 110 kg and 74kg compared to European averages of 160-200 kg and 90-110 kg; all the linear measures ,such height at the withers, are 8-15 % lower and the sexual dimorphism, very evident in European

specimens, results in Mesola's ones reduced. Male fawns should be approximately 10 % heavier than females ones at birth but in this case this gap isn't showed; furthermore Mesola deer present a general slower body development that can be noticed in the later achievement of final sizes, in stags estimated around 10 years, in hinds 7-8 years. Another relevant aspect is the shortening of limbs: the height at the withers normally should be around 63% of the head – tail length but in Mesola specimens results down to 58%. At first glance the most marked difference between this population and European ones is the antlers structure. On adults antlers carry six tines, three for each beam, that compared to a normal antlers structure represent exactly the half. What is missing usually are the royal antler and the crown and these features can even disappear throughout generations, fact actually happened in the period 1957-1997. The final structure cannot be often observed before 10 years. Another relevant difference, last but not least, is the light white mottle on summer coat that is typical of fawns but that in Mesola specimens remains also in adults, especially on the legs area. Summarizing all these characteristics a conclusion can be reached: this population is an ecotype developed in conditions of low production environment, pushed to limit their body development to face the lack of trophic resources that can guarantee a normal growth. This population didn't have the opportunity to roam thriving fluvial forests like others, they have been forced to inhabit an environment build up on poor sandy soils; they adapted differently so is not worthy for them spending too much energy for example in the formation of a complete antlers structure.

Picture 3.2: Mesola's stags in Elciola (Photo Baratelli,2013).

3.3 Demography and population dynamics

It's very hard to trace a pattern of the size of the population from scratch but there have been several estimations during the last hundred years that have been made by different researches with different methods. The basic problem is the reliability of data, not always very clear. The first data were collected on the request of the zoologist A. Ghigi and the population has been estimated on around 200 heads but it's not very trustworthy the method the research has been carried with. From 1922 to 1936 the number passed from 160 to 300 while during the postwar period (1945-47) the number dramatically decreased to about ten individuals. There is a fact that needs to be taken in account; until the withdrawal by the National Forestry Services, the Natural reserve was subjected to hunting, sometimes not always sustainable, reason why few times the deer risked to be wiped out. In 1972 a fence in the location of Elciola was built up bringing to the formation of two different subpopulations. The first proper censuses were conducted by S. Mattioli in 1982 resulting in 90 specimens. In 2006 the number approximately came close to 120 heads. The graphic below shows the trend of the population's size based on data collected from 1911.



Graphic 3.3: trend of Mesola red deer's population size from 1911.

The recovery of red deer here is due also to conservation plans that have been followed in the last decades: for example the huge presence of the fallow deer was dangerous for competition: hinds were giving birth every 2-3 years, population was getting old and a generational turnover was not guaranteed. In 1982 adult stags over 10 years were 10% of the total population, in 1986 it was of 50%. It followed a demographic crisis but the adoption of conservative plans, such the reduction of fallow deer and the administration of foraging, helped the recovery of the population. The birth rate passed from 2.7 fawns on 10 females to 3.7 fawns on 10 females, the survival rate of fawns got twice higher and the mortality rate of adults decreased from 12 % to 6% (Mattioli *et al*. 2003).

Picture 3.3: Hinds with fawns gather in open spaces, in Elciola (Baratelli,2013).

3.4 Fallow deer competition

Interspecific competition originates when different species utilize the same limited natural resources and the increase of one determinate the decrease of the other one. Theoretically two sympatric species should develop adaptations but when different aspects as time, space and food come to overlap to each other, competition may burst out. Species introduced by humans cause lot of times competition and usually alien species are stronger and more capable to adapt, carrying to the loss of the indigenous species. The interactions between wild ungulates are difficult to analyze deeply in nature and there is lack of information; The competition between ungulates involves mostly overlapping of trophic resources and habitat and behavior interferences are very rare in herbivorous species . Observations derive mainly from specimens living in captivity. In Gran Bosco della Mesola the direct competitor of red deer is the fallow deer, an alien species introduced in Europe by men and characterized by an opportunistic diet. It can overlap with other deer's species and it showed also interspecific aggressiveness; this has been figured out in Maremma Regional Park where it was able to chase away the roe deer (*Capreolus capreolus*) from pasture areas also through direct aggressions.

The fallow deer was surely present in the reserve at least since the end of XVI century but it was wiped out around the 1945 and reintroduced newly between the 50s and 60s. In this environment the fallow deer found a thriving place to develop so that in the period 1980-1999 a number ranging from 300 to 1000 units was estimated (Mattioli *et al*., 2003). It has been calculated that the trophic activity of fallow deer in this period rotated around 1.4-4.5 t of biomass consumed each day. A direct consequence of overgrazing in meadows where the growth of desirable grass results compromised and in the undergrowth the plant renovation is threatened. And the fact that the two species are operating on a closed and relative small area of 1000 ha can increase the possibilities of the rise of a competitive interaction. A research carried out in UK pointed out a pretty similar use of resources and habitat by the two ungulates and moreover in captivity the fallow deer was pushing away the red deer from artificial sources of food. But in other cases and in nature also opposite behaviors have been observed, like the cooperation against a possible predator, like a wolf, but in the case

of Gran Bosco dela Mesola where enemies for deer don't exist it was difficult to expect a positive interaction. After all these considerations it cannot be said that exist a competition on all levels between these two species but it's evident that it can occur in various situations. During the drafting of the "Naturalistic Management Plan" in 1984 was identified the necessity of protect the population of red deer from the constant enhancement of fallow deer; firstly it has been looked for a solution not colliding with ethic principles and it was found in the capture of living animals and in their subsequent transfer in other suitable areas. The first attempt consisted in catches with flying nets after pushing the animals in arranged areas but this couldn't ensure selectivity on captures and undisturbed activity for red deer so this method was rapidly dismissed. Were arranged then fences for catch with snap closure openings allowing the capture of 1683 animals in the period 1983-1996. But fallow deer gradually learnt to avoid the traps and along the difficulties on allocating the animals in other areas it became clear that another approach needed to be found. In the timespan 1995-2000 it was tried the firearms solution and many specimens as the annual estimated population increase were killed, not guaranteeing the eradication of fallow deer. Another plan was outlined and it was focusing on two aims: increasing the continuity of the withdrawal throughout the reserve and the zoning in macro-areas in order to facilitate silvicultural interventions and the fallow deer management. The purpose is to remove completely this animal area by area, fencing them so that the fallow deer control would be easier and ensuring more protection to the plant renovation.

Beside the direct interventions against fallow deer other operations have been carried out aiming to the requalification of the territory and the environment: mowing operations, plowing and irrigation during dry periods through motor-pumps were few of these measures promoting the natural regeneration. And to help directly the red deer they were provided daily with about 0.5kg for head of fodder during summer and winter months, when rainfalls are lower.

Picture 3.4: Fallow deer grazing in the Natural Reserve (Photo from www.parcodelta.com).

3.5 Poaching

Until the institution of the Natural Reserve, ungulates here have always been hunted and after the purchasing of the area by National Forestry Services this phenomenon went on as an illegal activity, the poaching. It's thought that this practice is very ancient and that it lasted until the end of 70s. Many aspects brought to the decline of this phenomenon, first of all the improvement of the wellness of local settlers. The small scale economy here is based nowadays on shellfish culture and a specialized agriculture of vegetables that brought to a gradual decrease in poaching, also due to the disappearing of the historic responsible of this activity.

It's evident that this phenomenon influenced negatively the red deer population of the Reserve but now it is kept under control by the local police corps. Furthermore nowadays is spreading around the local people a better awareness about the danger connected to this practice.

3.6 Genetic characteristics and risks

The genetic variability meant like evolutional potential results necessary for long-term survival of a population because determines its ability to respond to environmental pressures and changes. The first genetic study on Mesola red deer was carried out in 1998 (Lorenzini *et al*. 1998) and it consisted in the analysis of about 40 alloenzymatic loci that showed up a very limited genetic diversity. Other analysis were conducted on mitochondrial DNA that identified the presence of just one haplotype, signal of mitochondrial variability equal to zero while the microsatellites loci (Short Tandem Repeats), a DNA area of nucleus, showed this low diversity as well (Hmwe *et al*. 2006, Zachos *et al*.,2009). The reason concealed these results consists in Mesola red deer's troubled history; reproductive isolation, long stays at low population sizes, exaggerated hunting are few of the causes of this precarious genetic situation. The high rate of inbreeding can be witnessed in the significant deficiency of many specimens that present a reduced fitness and morphological malformations; it is estimated that in the timespan of ten generations occurs a genetic variability loss of 30% in Mesola red deer, alarming statistics that establish the inability of this population to respond to environmental changes, putting it in a serious risk for its survival. Beside these worrying facts, the DNA studies revealed the unicity of Mesola red deer since have been shown relevant differences in sequences from European deer and Sardinian deer. This discover represents a very important result that must be taken into account and that demonstrate the immense value of this species.

4 MATERIALS AND METHODS

The task of this work is the collection of data concerning Mesola red deer's roaring activity and its analysis in order to continue and implement a project of study about this native population, trying to get deeper on its knowledge through the survey on various aspects. This research has been carried out following two alternative methods: data collection through paper tabs and by recorders. Both the activities were held in the location of Elciola, in three different parts; this work will focused on data collected in the northern spot.

4.1 Data collection through paper tabs

This practice consisted in the analysis of roaring activity recording data manually on paper sheets; this method requires the operator's presence on the spot at the moment of collection. The operator had to listen for three hours and write down on the paper all the roars he could hear. On attachment 6 can be found enclosed the tab used for recording data. The timespan chosen to better catch the vocal phenomenon includes the Astronomical Sunset (AS) and more or less is between 18:00 and 21:00 since this part of the day is known to be the most exploited by deer for their activity. The tabs are divided in intervals of 10 minutes where the operator must sign every heard roar and its respective deer with a practical method utilized also in silviculture by forestry men to sign the trees designed to cut. To ensure a better work, also the azimuth of each active deer has been written down thanks to the use of a compass. The operator during these hours sat down in silence on the border of Elciola close to mangers where it is supposed to occur a more intense activity, trying to interfere less as possible with deer's roaring. Furthermore It has been registered every kind of noise that in any way could have interfered with deer's roaring, signing the duration of this disturb as well. Among continuous noises can be considered meteorological events such rainfalls, wind and storms; deer being wildlife tend to flee and to be cautious when in the surroundings there are disturbs so they need quiet places for feeding and roaring. An intense rainfall or a strong wind prevent them from listening clearly what they have around and consequently to perform completely their activities. Other recorded disturbances have been dog's barking coming from close farms, a quite constant noise of boats and of the harbor nearby in Goro, cars and motorbikes in the distance sometimes could have been heard very clearly when the air was static, occasional voices of workers and visitors close to Elciola and above all the noise deriving from the passage of plain over the Reserve, being the Po delta a busy crossroads of flights. The local event "Sagra del Radicchio" of the close town Bosco della Mesola have been clearly heard throughout its duration by the operator. The observations didn't run each day all the mating season long but few sample days within it have been taken due also for weather adverse conditions and other logistics problems that didn't allow a more significant collection. These days of the roaring season 2013 are 24/09, 30/09,

03/10, 09/10, 10/10, 16/10 and 22/10.

Picture 4.1: the view from the data collection spot on the border of the meadow Elciola (Photo Baratelli, 2013).

4.2 Digital Data collection through recorders

The second method consisted in the analysis of the vocal activity recording roars through a digital device programmed exactly for wildlife: Song Meter ™, an instrument made available from Wildlife Acoustics ©. Three of these devices have been hanged on trees in high activity areas of Elciola, in this work will be analyzed data from the one located in the northernmost part. The period of recording runs from the 17th September to the 3th November 2013.

Song Meter ™

This instrument consists in a bioacoustics monitoring system used especially in wildlife and birdlife studies and its hermetic and weatherproof characteristics make it ideal for these recordings outdoor even in adverse meteorological conditions. Its shape

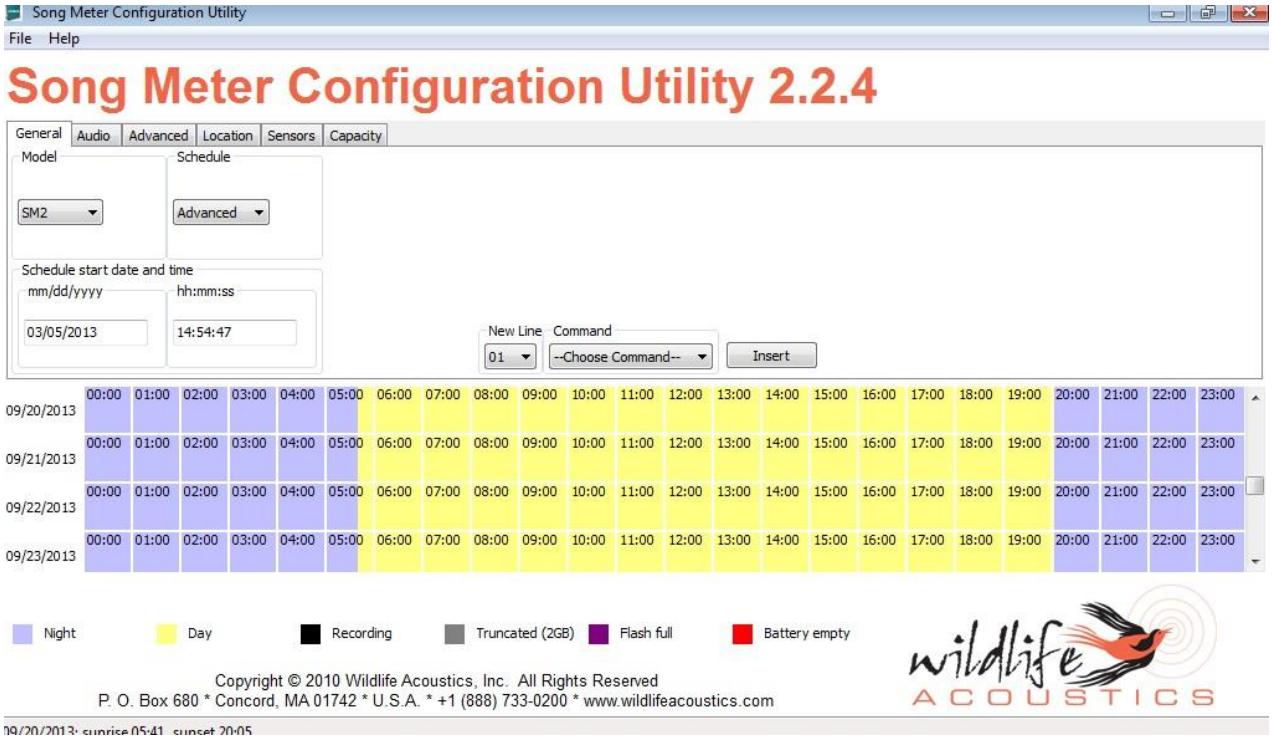
reminds quite to a plastic box and it is made up by two external opposite stereo-microphones connected to the mechanisms of the recorder that can be easily scheduled thanks to a screen and several buttons. The weatherproof enclosure can be opened with the help of a screwdriver.

Picture 4.2: inside view of Song Meter ™ without enclosure (Photo from www.fs.fed.us).

The device is internally powered with 4 D-size alkaline batteries that with the chosen settings allowed a duration for around 3 weeks, recording each day 6 hours but to prevent accidents or wrong forecasts it has been decided to change them more often. There are also two slots (A and B) for SD (Secure Digital) or SDHD (Secure Digital High Capacity) cards but only one has been utilized putting one 16 GB card. It was very important to confirm the right settings otherwise there's the risk to fail the recording; After a correct scheduling it was possible to "send to sleep" the recorder to save battery until the established registering time, when the device would have automatically started to work. The recording settings need to confirmed on the instrument itself but the scheduling had to be done on the card via computer with the program Song Meter Configuration Utility, of which will be talked in the following paragraph.

Song Meter Configuration Utility 2.2.4

This program, whose rights also belong to Wildlife Bioacoustics© , is necessary to configure the desired settings for recording subsequently with Song Meter™ instruments before putting the scheduling on the memory card.



Picture 4.2.b : display of the Song Meter Configuration Utility .

The window showed in the picture is the first of six displays of the program ;in all of them can be visualized a table representing the daily trend depending on selected settings; for example in the picture it is showed the timespan from 20/09/13 to 23/09/13 with the respective astronomical sunrise and sunset corresponding to the two lines separating yellow (day) to grey (night). The most important settings can be summarized as follows:

General: this option allows to manage the duration of the recording through the voice "choose command" establishing starting point, length and number of days. After the set up black lines will appear representing the effective recording period, the purple

indicate that the card is full while the red show when the battery is supposed to be over. It was choose to record from 17:00 to 23:00.

Audio: on this section is possible to customize the sample rate (Hz) of recording; it was chosen 24000 Hz. The other two voices were “Channels Stereo” and “ Compression Off”.

Advanced: under this section all settings were left of default.

Location: this window is very important for a correct scheduling. Is it possible to name the recordings with a prefix , in this case ELN to point out the location North Elciola and to choose the time-zone corresponding to +1 for Italy; The “solar mode” identifies four alternative settings (Sunrise/Set, Civil, Nautical and Astronomical) that show differences in timetables night and day duration. In the end it’s important to not forget to write down the coordinates of Gran Bosco della Mesola, 44.50 N (Latitude) and 12.15 E (Longitude)

Sensors: under this section all settings were left of default

Capacity: in the last display it is possible to schedule up to four SD cards but with the device available to us a maximum of two was allowed even if it was established to utilize just one.
In the section “power consumption” it has been chosen an internal power source and an alkaline “battery type”.

As final step the scheduling has to be saved on the SD/SDHD card in order to ensure that the program will work throughout the established period. After this the card has to be inserted in the slot of the Song Meter recorder and to follow the steps previously showed.

5 DATA ANALYSIS AND DISCUSSION

In this paragraph will be analyzed all data collected throughout the rutting season, both on paper tabs and obtained by recorders.

The data collected by the operator manually on-the-field on paper sheets have been subsequently re-organized in excel spreadsheets and used for comparisons with digital data. It has been decided to not analyze paper data itself since they are not enough to describe a truthful trend of the mating season but only related to digital ones.

5.1 Digital data analysis

To analyze these data it was chosen to utilize the free platform Audacity®, a software made for recording and editing sounds. The total of data collected amounted to 264 hours, divided in 44 days 6 hours each from 17:00 to 23:00. The days 24th September, 28th, 29th, 30th October the Song Meter for unknown reasons didn't work causing the loss of these data. Due to the huge quantity of records, it was utilized a sampling method to listen to the data, exemplified in the following tab:

	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
1°h												
2°h												
3°h												
4°h												
5°h												
6°h												

Tab 5.1: scheme of the sampling for data's listening.

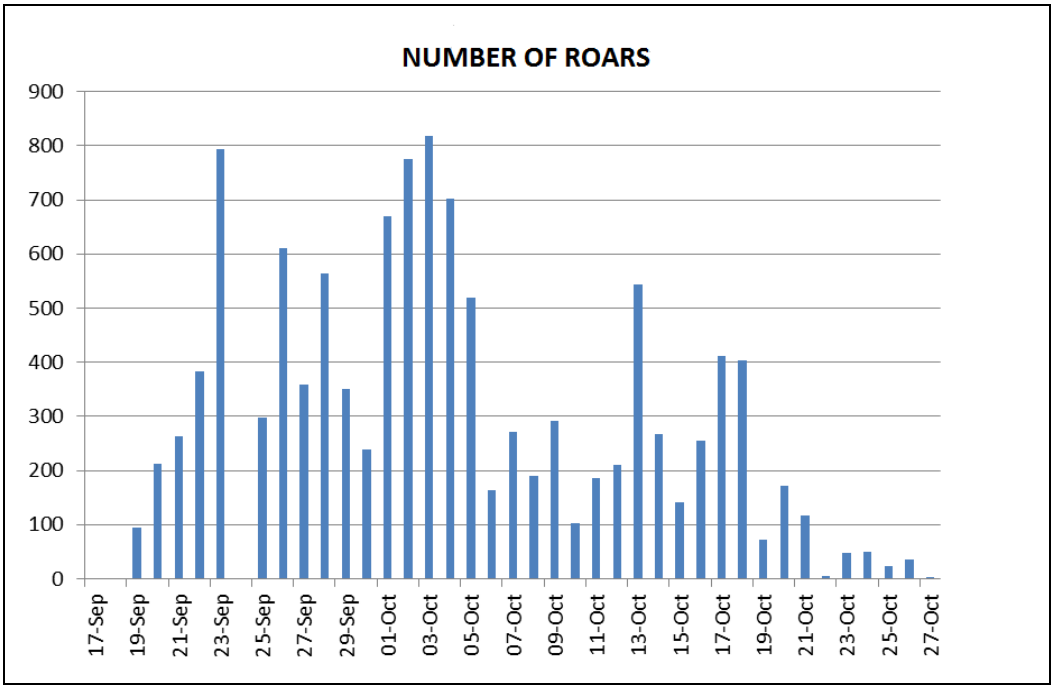
The red intervals of five minutes each are those ones that for every day have been listened; there is a skip between each other of 15 minutes, exception made for those

ones at the beginning of each hour that are consecutive. For each day was listened 110 minutes and considering all the others a total of 4840 minutes was analyzed. Compared to the one-minute interval, this sampling allows to understand better the roaring moment you are going through: stags usually don't roar for just one minute but they do for longer periods so with this method is possible to catch a "roaring moment" of a deer, perhaps obtaining a more truthful result.

The Audacity ®software will be described later when will be introduced the visual method.

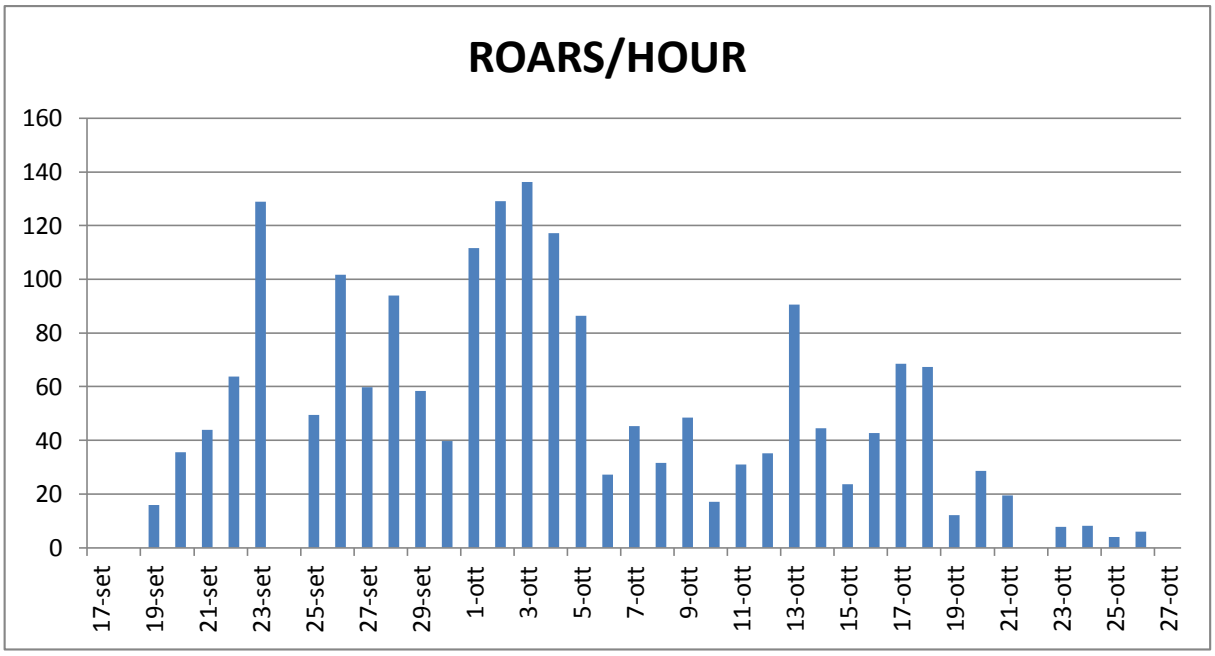
Total amounts of roars throughout the rutting season

This graphic collects all roars heard on digital data analyzed through Audacity ®Software. The peak corresponding to 817 has been reached on the 3th October while the records from 31/10 to 3/11 haven't been included because no activity here was noticed.



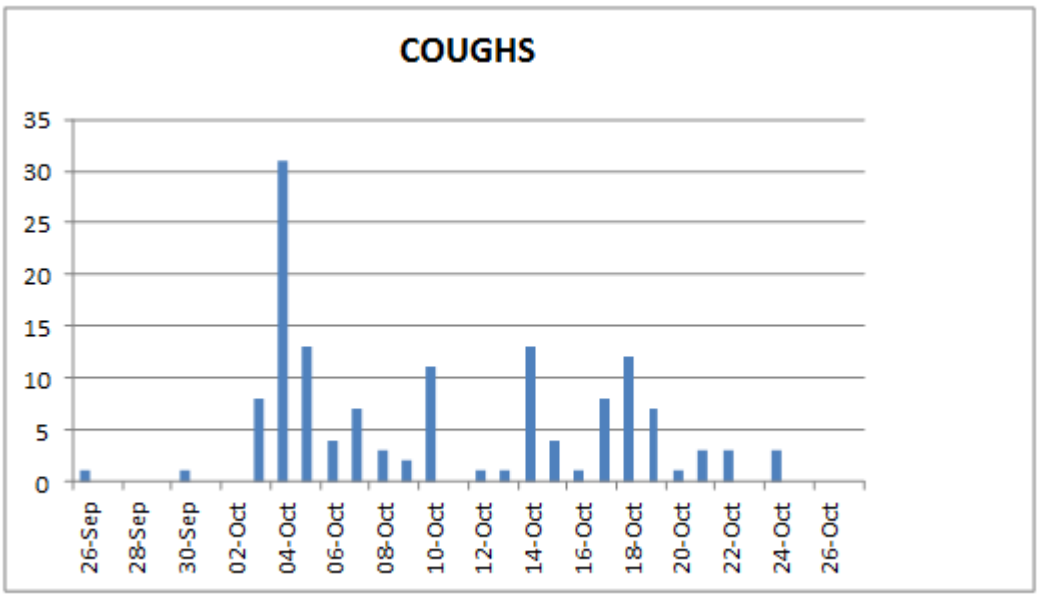
Graphic 5.1.1 :Total number of roars per day throughout the rutting season by digital data.

Analyzing the trend of the graphic, it can be observed that the period running until the 4th October is characterized by two peaks, the 23th September with 773 roars and the timespan 1-4th October (670 – 775 – 817 – 703 roars) followed by a significant drop; around mid-October the activity shows an increment culminating on the 13th with 544 roars and then a gradual decreasing until the end, estimated around the 31th October. A wider framework can be achieved if we consider also the roars number per hour in order to have a closer look:



Graphic 5.1.1 b: Representation of the trend of roars/hours obtained by digital data.

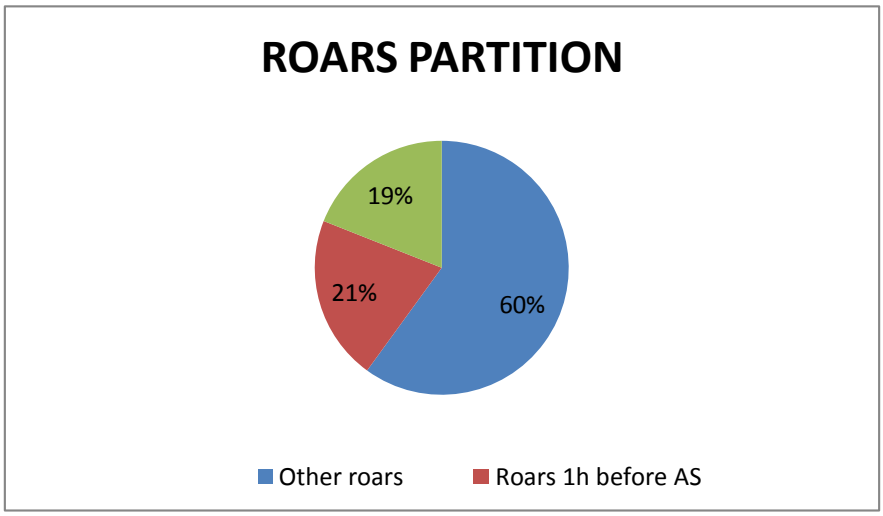
Nothing changes from the previous graphic but on the latest one it can be observed on a smaller scale the size of the roaring activity with the analysis of digital data; the 3th October, the highest activity day, presents a value of around 136 roars/hour. Beside roars, during the listening activity also the number of coughs were taken in account and the peak was identified in 31 on the 4th October.



Graphic 5.1.1 c: Coughs trend throughout rutting season obtained from digital data.

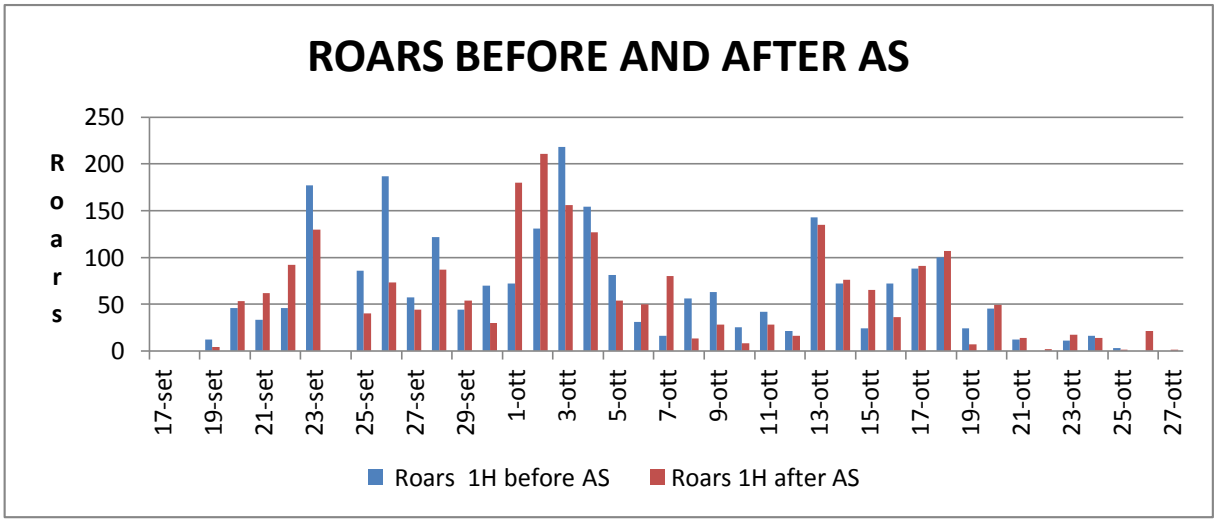
Comparison between roars number before and after AS

Another analysis has been carried out to investigate the level of the roaring activity between the astronomical sunset and it was chosen to take into account the previous and the following hour. The test is based on digital data as well so it consider not the whole hour but the intervals chosen to represent the sample.



Graphic 5.1.d: diagram representing the percentage of roars before and after AS on the total.

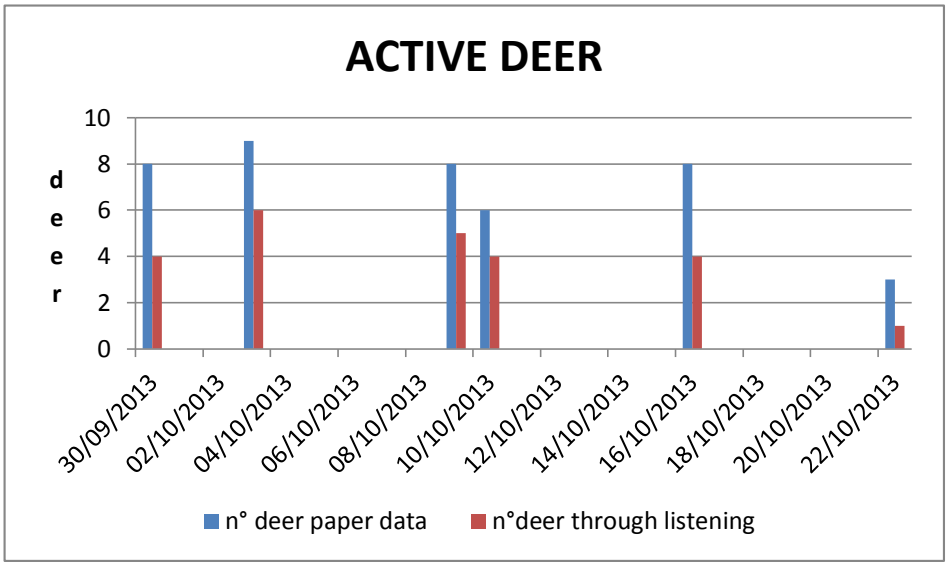
The overall number of roars before the Astronomical Sunset amounts to 2400 while the value standing for roars after AS is 2256. In percentage they correspond respectively to 21% and 19% of the total number of roars making up the 40% of it. This method points out that a big part of the roaring activity is concentrated on the period around AS, due to the effect of changes in photoperiod: the secretion of melatonin is higher during the night and it stimulates the release of testosterone as well bringing to the intensifying of the phenomenon. This analysis shows also a higher activity before the sunset with respect to the one after. The trend of the graphic is similar to the one representing the total number of roars during the mating season and it can be observed that the day with more roars concentrated around the astronomical sunset is the 3th October. The reason standing behind a not so relevant difference between the activity before and after the sunset consists in the fact that often the number of intervals taken into account is different considering the hour before and the successive hour; it depends from the position of the astronomical sunset.



Graphic 5.1.e: trend during the rutting season of roars before and after AS.

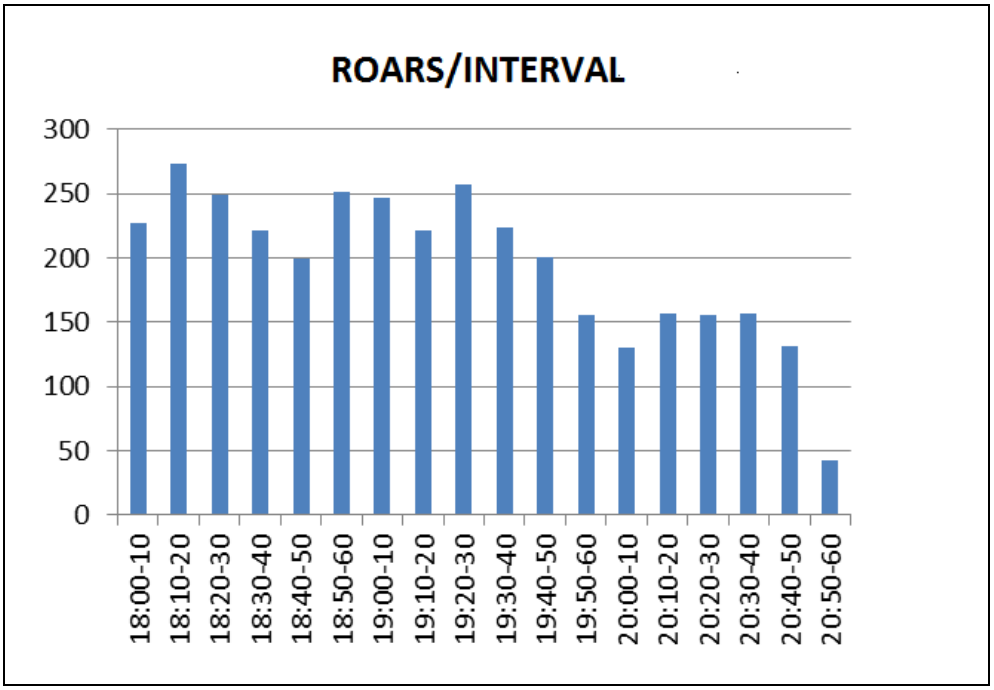
5.2 Comparisons between digital data and paper data

As it was previously said, makes no sense to trace an overall trend of roaring activity along the season based on paper data because they are not sufficient to represent a truthful proof. But some interesting conclusions can be figured out by comparing them with the respective ones gained from digital data listening. First analysis is focused on number of active deer identified through observations on-the-spot and from listening the records considering those days whose paper data are available.



Graphic 5.2.a: Comparison between number of active deer identified on the spot and listening.

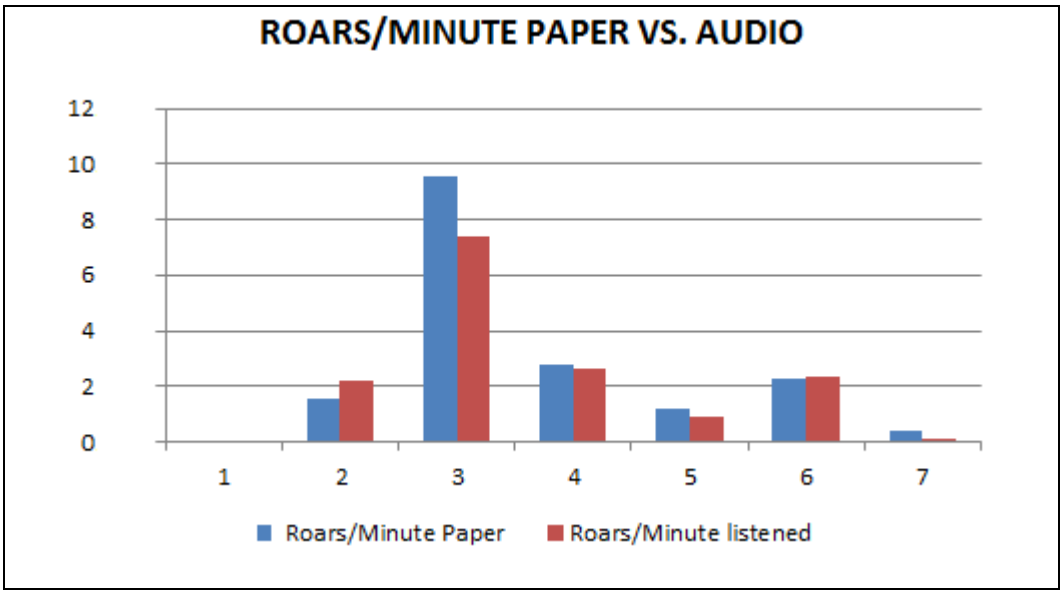
It was easy to expect such representation resulting in the higher number observed directly on the spot: registering in loco the deer roaring is easier because is connected to the possibility of identifying the direction of roars with the use of the compass and before the dark hours also by looking directly to deer and following their movements. The number of deer is consequently higher. Listening to digital data makes easier counting the roars but then it's more difficult to distinguish to different deer; the most common mistake is to confound one deer's roaring with others, bringing to a lower and less reliable result.



Graphic 5.2.b: number of roars for interval of paper data for all days observed.

The advantage of paper data is that they represent a time span of three continuous hours so inside the three registered hours is not necessary to create samples since all data are available. In the upper graphic is showed the trend of roars for every 10-minutes interval for all days paper data are available. The roaring activity is concentrated mostly in the first half of the observations work with a peak in 18:10-20 interval with 273 roars. It's important to take in consideration that the analyzed days range from the beginning to the end of mating season so that the AS shifts continuously. For this reason roaring higher concentrations from day to day may vary and change along with AS.

Comparing paper data and digital data is a careful operation and its difficulty stands behind the incompatibility of intervals examined; the risk is a wrong estimation of the parameters calculated without reaching a clear and right solution. A good way for compare the two groups of data seemed to be a confront at the level of roars per minute listened; for paper data the total number of roars of each day has been divided for 180(3h) whereas for digital data the total number of roars for respective days for 110, the effective duration of every analyzed day. The results are shown in the following diagram.

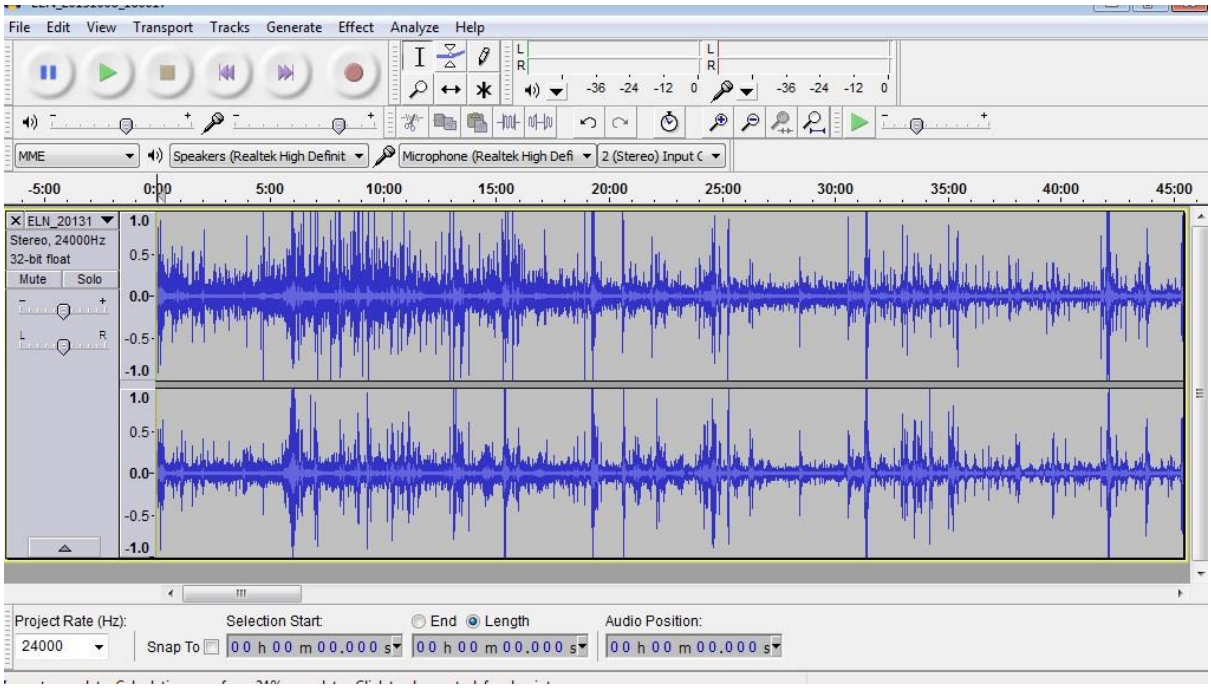


Graphic 5.2.c: Comparison between roars/minute for both paper and digital data.

The 3th October the highest difference is shown (9.577 against 7.427) but beside this day the gap between digital and paper results seems to be not that huge, confirming a quite truthfulness of the operation.

5.3 Listening method and visual method

All digital data have been listened in order to obtain a stock of data sufficiently truthful to describe the trend of the breeding season. The platform used is Audacity that has already been introduced before. The listening method simply consists in writing down all the roars heard during the chosen intervals. It's a long method since it requires for each recorded day almost 2 hours of listening.



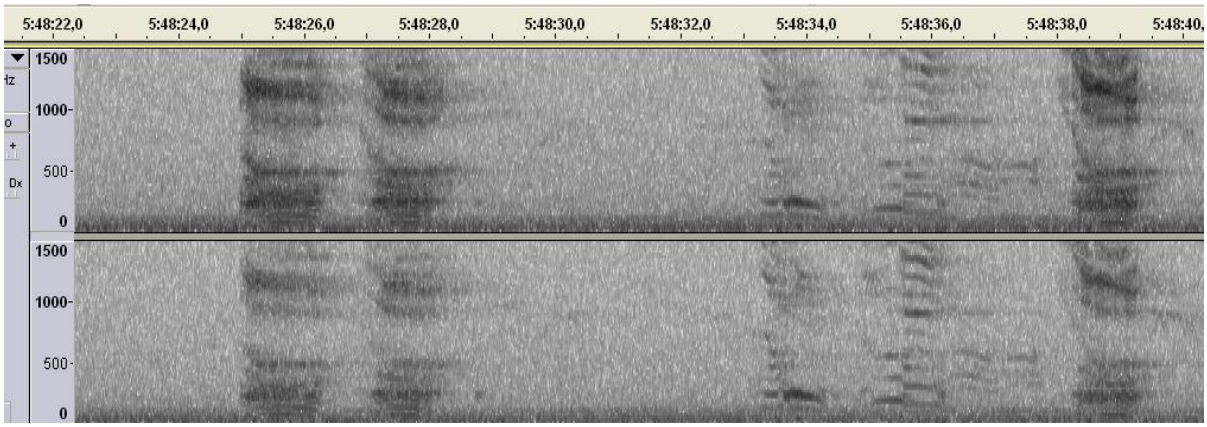
Picture 5.3: screenshot of the interface of the free platform Audacity®.

In the upper picture the interface of the software shows the waveform of the program; on the horizontal axe the time can be zoomed in and out ad lib while on the vertical axe the frequency (Hz) can be also modified. The selected day (06/10/13) presents a trend typical of a windy and rainy day since the high frequencies peaks correspond to the powerful acute sounds of the wind on the stereo microphones of the Song Meter™ recorder. There is a further method that can be helpful to verify the reliability of the listening method: the visual method. It consists in an expeditious and fast method that can implement the analysis; the task of this comparison is not the counting of statistical parameters but rather the proof that these two methods can be both used to achieve the same purpose, to be substitutable. The visual method has been carried out analyzing the spectrogram of the record by counting the spectra corresponding to roars.

It was decided to choose two samples for making this test:

- Ten 5-minutes intervals that presented the highest number of roars
- Ten 5-minutes intervals randomly chosen throughout the season

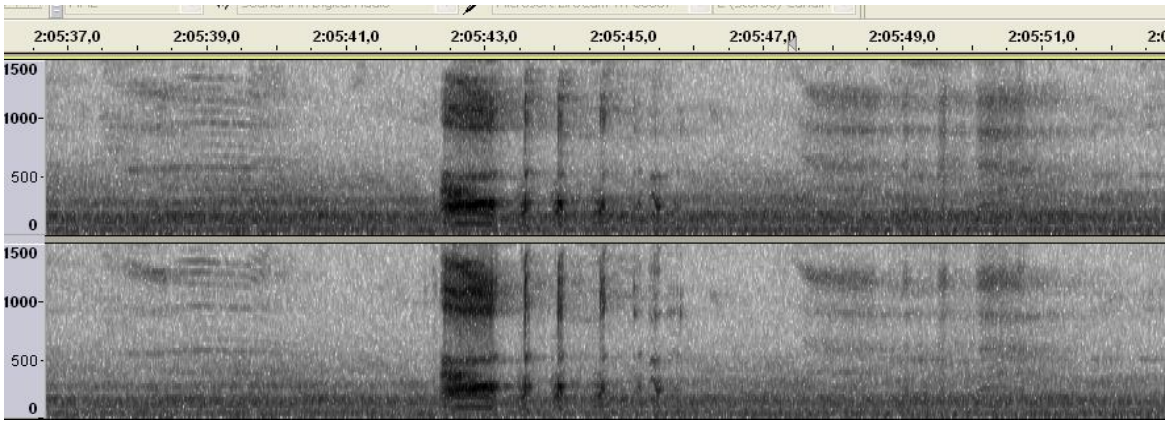
This choice is based on two principles: the first is that the more roars presents the interval the most difficult is the identification of roars because different roars can overlap on the spectrogram, becoming difficult to distinguish as different roars. The problem deriving from this choice is that the operator can be influenced in counting the spectra since he start to count already knowing the final number. So other ten intervals were chosen randomly blindly.



Picture 5.3.1: Typical spectrum of a deer, easy to recognize in absence of disturbances.

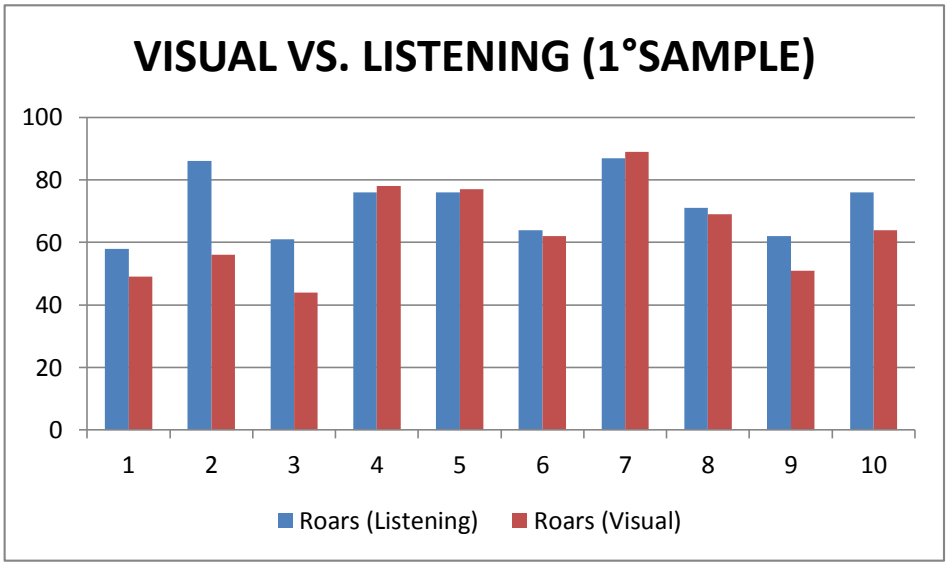
To identify the spectra of roars on spectrogram settings were chosen:

- Window size: 1024
- Maximum frequency (Hz): 1500
- timespan on screen: 18 seconds



Picture 5.3.2: Spectra typical of a deer's cough.

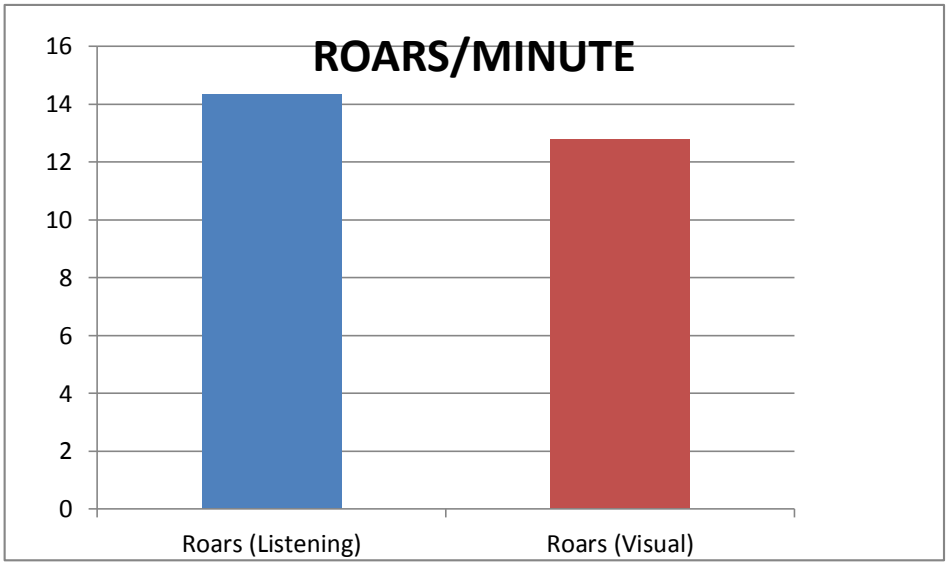
The intervals chosen for the comparison through the two methods can be found on the attachments;



Graphic 5.3: Comparison between the two methods of the first sample (Highest number of roars).

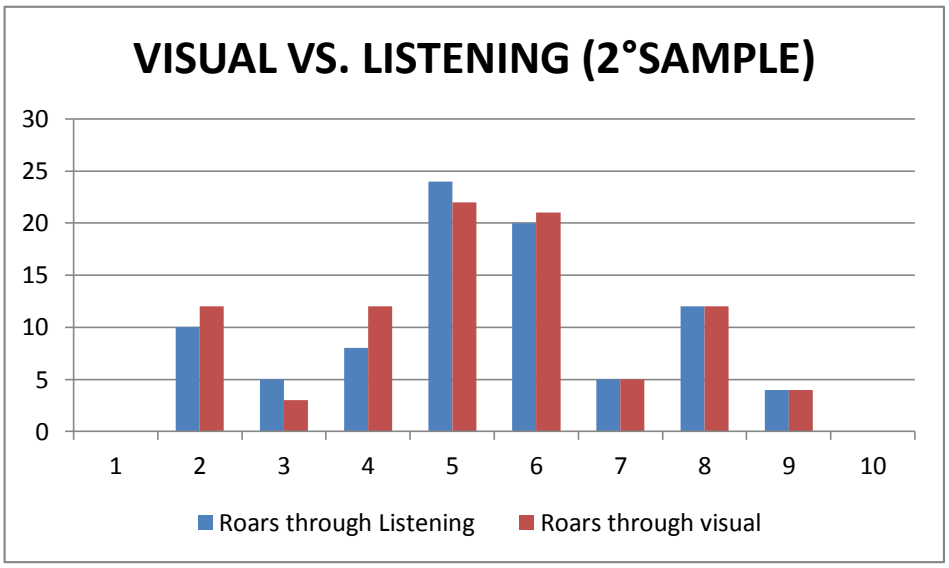
The result deriving from the analysis of the first sample shows that through the visual method it is obtained a lower value (639 for all ten intervals) than the audio method (717 for all ten intervals) but the gap showed in the graphic is irrelevant for many intervals, demonstrating a quite truthful result. The difference between the two methods can be expressed also in terms of roars/minute. The value for listening is

14.43 while for the visual is 12.78 (roars/minute).



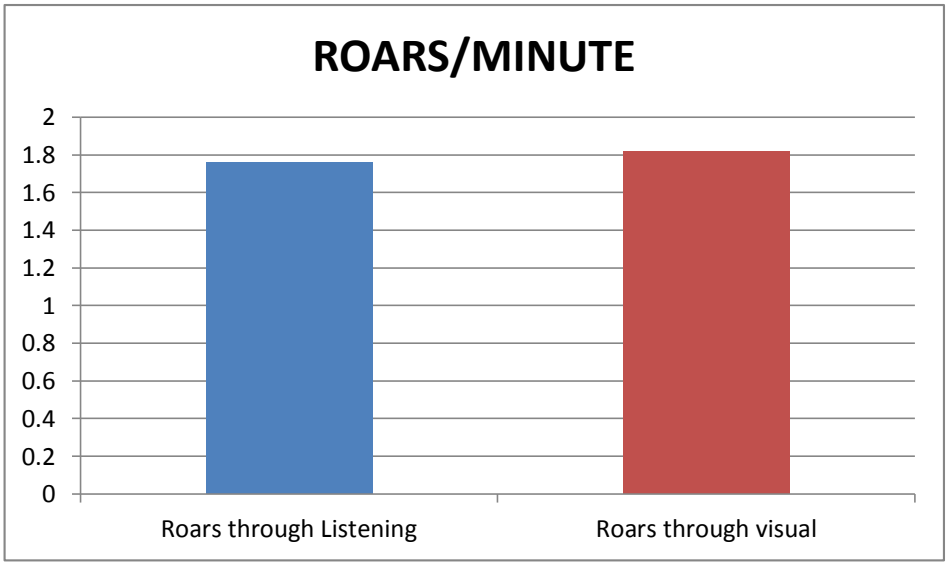
Graphic 5.3.a: The result based on roars per minute shows a small difference.

The conclusion deriving from the examination of this sample is very optimistic but there is the risk that the fact of knowing already the number of roars obtained through the listening method could have in some way influenced the counting; It was chosen then to examine other ten 5-minutes intervals chosen without knowing the "listening data". The tabs related to this samples is available on final attachments.



Graphic 5.3 b: comparison between the two methods for the second sample.

This sample chosen randomly presents lower values but the truthfulness of the results is outstanding. The roars heard with the visual method are 91 and while the sample analyzed with the listening method is 88, almost the same value. This can be expressed in terms of roars/minute:



Graphic 5.3 c: The second sample is represented in terms for roars/minute

This graphic points out the very subtle difference between the two methods, confirming the truthfulness of the visual method as supplementary for the listening operation. The use of visual method implements the analysis and is a good way for assessing its final results. Despite what we expected, disturbances were a weakly influencing factor as well (De Stefano, Tesi Magistrale, 2013).

CONCLUSIONS

The 2013 rutting season of Mesola red deer started on the 19th of September and it finished supposedly between the 27th and 30th of October since during the following days no activity has been registered and for technical problems recordings from 28th to 30th were lost not allowing an exact establishment of the end of the roaring season. The trend extrapolated from data showed differences from other analysis of previous years. If for the first part of the period the trend is similar with a peak corresponding to 23 September like in 2010 (Casarin, M.) what is changing is the highest activity estimated from 1-4th October when it should show a temporary decrease. On the 3thOctober the maximum peak was recorder on both paper (1724) and digital data (817). Around the half of October occurs a new increase, though lower, that culminates on the 13th October with 544 roars. The differences observed can be partly explained because for 2013 season was adopted a new sampling method in choosing intervals: in 2010 for every 10-minutes interval were listened 2°,6° and 9° minutes on seven hours with a total of 126 minutes for evening while in 2013 roars were counted following the tab 5.1 with 5-minutes continuous intervals on a total of 110 minutes listened. But this cannot be considered the reason of the above differences since similar seasons should show a proportional trend not entirely observed here. The analysis on digital data went on considering other values: the roars/hour trend is obviously proportional to the total number of roars with a peak of 136 roars ca. per hour. The counting of coughs revealed that the phenomenon is almost absent in correspondence of the first peak but it reached a value of 31 coughs on the 4th October. Digital data have been further analysed related to AS, comparing the number of roars the hour before with the ones of the hour after AS for each day; the results showed a low prevalence in percentage in the hour before than in the hour following with respective values of 21% and 19% of the total; even if representing a big part of the total a higher value was expected and this might be due to the fact that the gradual shifting of AS day after day caused a different inclusion number of intervals in the counting between the two analysed hours, resulting in the effective data.

Paper data haven't been collected in a continuous way like digital ones and because of this isn't possible to trace a truthful trend of the season but the available data have been used for comparisons with digital data. Those signed on paper sheets were useful for estimate the approximate number of active deer, evaluated on nine specimens and resulting more truthful than digital data where occurs a relevant underestimation. Paper data itself have been used for calculating the roars frequencies on the 10-minutes intervals and the highest activity was observed in correspondence of 18:10-20 interval and more in general in the first 1 ½ hour of the census. Another interesting analysis has been carried out on digital data aiming not to count roars but to measure the efficiency of two alternative methods running to the same purpose. The listening method is the same utilized to obtain data discussed until now and for those heard intervals the result is realistic but at the same time quite long since every day needs almost two hours of listening. The visual method is faster and consists in the analysis of the spectrogram of the recordings counting all those spectra corresponding to roars; the method is expeditious but the fear was that disturbances and the prejudice for the already-got knowledge of data could somehow influence the counting of spectra. The choice of high roar concentration intervals showed a good result due maybe to compensation and that roars are generally underestimated compared to listening and on the other side the choice of ten random intervals revealed a great truthfulness of comparison.

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ATTACHMENT n°1

Analysis of digital data re-organized day by day in tabs. 24th September and the interval 28th – 30th October are missing for technic problems; 17-18th September, 31th October, 1-3th November are excluded because of absent activity.

19-set-13

Starting Point 17:00
Ending Point 23:00

Astronomical Sunset 19:54
Weather n.a

			N.Roars	N coughs	N deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		1	0	1	Thunder
	17:40 - 45		2	0	1	
2° hour	18:00 - 05		9	0	1	Shot
	18:05 - 10		2	0	1	
	18:25 - 30		0	0	0	Car
	18:45 - 50		9	0	1	
3° hour	19:05 - 10		1	0	1	
	19:10 - 15		2	0	1	
	19:30 - 35		3	0	1	Plane
	19:50 - 55		7	0	1	Plane
4°hour	20:10 - 15		3	0	1	
	20:15 - 20		0	0	0	
	20:35 - 40		0	0	0	Car
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		3	0	1	
	21:20 - 25		3	0	1	
	21:40 - 45		17	0	3	
6°hour	22:00 - 05		19	0	3	Plane
	22:05 - 10		5	0	2	
	22:25 - 30		9	0	2	
	22:45 - 50		0	0	0	Plane

TOT Roars 95 0
TOT Deer 3

20-Sep-13

Starting Point 17:00
Ending Point 23:00

Astronomical Sunset 19:52
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		3	0	2	
	17:20 - 25		23	0	2	
	17:40 - 45		0	0	0	Car
2° hour	18:00 - 05		10	0	2	
	18:05 - 10		6	0	1	
	18:25 - 30		8	0	2	
	18:45 - 50		10	0	2	Plane
3° hour	19:05 - 10		14	0	2	
	19:10 - 15		11	0	3	
	19:30 - 35		14	0	3	Dog
	19:50 - 55		14	0	3	Plane
4°hour	20:10 - 15		16	1	2	
	20:15 - 20		16	0	2	
	20:35 - 40		14	0	2	
	20:55 - 00		2	0	1	Harbor
5°hour	21:00 - 05		15	0	2	
	21:20 - 25		5	0	2	
	21:40 - 45		1	0	1	
6°hour	22:00 - 05		5	0	2	
	22:05 - 10		0	0	0	Plane
	22:25 - 30		0	0	0	Car
	22:45 - 50		26	0	2	

TOT Roars 213 1
TOT Deer 3

21-Sep-13

Starting Point 17:00
Ending point 23:00

Astronomical Sunset 19:50
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		4	0	1	
	17:20 - 25		0	0	0	
	17:40 - 45		12	0	2	Plane
2° hour	18:00 - 05		4	0	1	
	18:05 - 10		19	0	2	
	18:25 - 30		10	0	2	
	18:45 - 50		12	0	2	
3° hour	19:05 - 10		12	0	1	
	19:10 - 15		10	0	2	Car
	19:30 - 35		11	0	3	
	19:50 - 55		8	0	2	Car
4°hour	20:10 - 15		8	0	2	
	20:15 - 20		26	0	3	
	20:35 - 40		20	0	2	Plane
	20:55 - 00		13	0	2	
5°hour	21:00 - 05		14	0	2	
	21:20 - 25		16	0	1	Plane
	21:40 - 45		0	0	0	
6°hour	22:00 - 05		29	0	2	
	22:05 - 10		12	0	2	
	22:25 - 30		12	0	2	Dog
	22:45 - 50		12	0	2	

TOT Roars 264 0
TOT Deer 4

22-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:48
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		5	0	1	
	17:40 - 45		8	0	2	Car
2° hour	18:00 - 05		10	0	2	
	18:05 - 10		7	0	2	Car
	18:25 - 30		2	0	1	
	18:45 - 50		20	0	2	
3° hour	19:05 - 10		4	0	1	Plane
	19:10 - 15		6	0	2	
	19:30 - 35		24	0	3	
	19:50 - 55		24	1	2	Plane
4°hour	20:10 - 15		20	1	2	
	20:15 - 20		26	0	3	
	20:35 - 40		22	0	2	
	20:55 - 00		15	0	3	Car
5°hour	21:00 - 05		9	0	2	
	21:20 - 25		9	0	3	
	21:40 - 45		27	0	3	
6°hour	22:00 - 05		40	0	3	
	22:05 - 10		16	0	3	
	22:25 - 30		53	0	3	Plane
	22:45 - 50		36	0	2	

TOT Roars 383 2
TOT Deer 3

23-Sep-13

Starting Point 17:00
Ending Point 23:00

Astronomical Sunset 19:46
Weather rain

			N.Roars	N. Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		12	0	2	
	17:40 - 45		58	0	3	
2° hour	18:00 - 05		31	0	3	
	18:05 - 10		35	0	3	
	18:25 - 30		86	0	4	
	18:45 - 50		53	0	4	
3° hour	19:05 - 10		61	0	5	
	19:10 - 15		23	0	3	
	19:30 - 35		51	1	4	
	19:50 - 55		41	0	4	
4° hour	20:10 - 15		20	0	5	
	20:15 - 20		46	0	5	
	20:35 - 40		23	0	3	
	20:55 - 00		30	0	3	
5°hour	21:00 - 05		14	0	4	
	21:20 - 25		24	0	4	
	21:40 - 45		49	0	3	
6°hour	22:00 - 05		32	0	4	
	22:05 - 10		16	0	4	
	22:25 - 30		30	0	4	
	22:45 - 50		58	0	3	

TOT Roars 773 1
TOT Deer 5

25-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:41
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		26	0	3	
	17:20 - 25		5	0	1	
	17:40 - 45		11	0	3	Plane
2° hour	18:00 - 05		25	0	3	
	18:05 - 10		19	0	3	
	18:25 - 30		26	0	4	Plane
	18:45 - 50		15	0	3	
3° hour	19:05 - 10		23	0	3	
	19:10 - 15		25	0	3	
	19:30 - 35		23	0	3	Car
	19:50 - 55		14	0	3	
4°hour	20:10 - 15		10	0	2	
	20:15 - 20		8	0	3	Car
	20:35 - 40		8	0	3	
	20:55 - 00		24	1	2	
5°hour	21:00 - 05		7	0	2	Moto
	21:20 - 25		6	0	2	
	21:40 - 45		0	0	0	
6°hour	22:00 - 05		4	0	2	Plane
	22:05 - 10		15	0	2	
	22:25 - 30		2	0	2	
	22:45 - 50		1	0	1	

TOT Roars	297	1
TOT Deer	4	

26-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:39
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		1	0	1	
	17:20 - 25		32	0	4	Plane
	17:40 - 45		31	0	4	
2° hour	18:00 - 05		24	0	4	Plane
	18:05 - 10		25	0	4	
	18:25 - 30		36	0	3	
	18:45 - 50		28	0	4	
3° hour	19:05 - 10		57	0	4	
	19:10 - 15		26	0	4	
	19:30 - 35		76	0	4	
	19:50 - 55		49	0	4	
4°hour	20:10 - 15		10	0	1	Helicopt.
	20:15 - 20		9	0	3	helicopt.
	20:35 - 40		6	0	2	Helicopt.
	20:55 - 00		10	0	4	
5°hour	21:00 - 05		35	0	3	Helicopt.
	21:20 - 25		37	0	3	
	21:40 - 45		32	0	3	
6°hour	22:00 - 05		21	0	3	
	22:05 - 10		23	0	3	
	22:25 - 30		24	0	3	
	22:45 - 50		18	0	3	

TOT Roars 610 0
TOT Deer 6

27-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:37
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		19	0	3	
	17:20 - 25		39	0	4	
	17:40 - 45		32	0	4	
2° hour	18:00 - 05		16	0	3	Plane
	18:05 - 10		3	0	1	Car
	18:25 - 30		26	0	3	Harbor
	18:45 - 50		20	0	3	
3° hour	19:05 - 10		20	0	2	
	19:10 - 15		13	0	3	
	19:30 - 35		4	0	3	Plane
	19:50 - 55		19	0	3	
4°hour	20:10 - 15		14	0	2	
	20:15 - 20		7	0	2	
	20:35 - 40		9	0	1	
	20:55 - 00		16	0	3	
5°hour	21:00 - 05		8	0	2	Harbor
	21:20 - 25		17	0	3	
	21:40 - 45		14	0	3	
6°hour	22:00 - 05		21	0	2	
	22:05 - 10		21	0	2	Plane
	22:25 - 30		3	0	1	
	22:45 - 50		18	0	3	

TOT Roars 359 0
TOT Deer 4

28-Sep-13

Starting Point 17:00
Ending Point 23:00

Astronomical Sunset 19:35
Weather n.a

			N.Roars	N coughs	N deer	Disturbes
1° hour	17:00 - 05		26	0	3	
	17:20 - 25		13	0	3	
	17:40 - 45		11	0	3	
2° hour	18:00 - 05		18	0	4	
	18:05 - 10		15	0	4	
	18:25 - 30		29	0	4	
	18:45 - 50		53	0	4	
3° hour	19:05 - 10		26	0	4	
	19:10 - 15		13	0	5	
	19:30 - 35		30	0	4	
	19:50 - 55		41	0	4	
4°hour	20:10 - 15		33	0	4	
	20:15 - 20		13	0	3	
	20:35 - 40		15	0	3	
	20:55 - 00		6	0	3	
5°hour	21:00 - 05		20	0	3	
	21:20 - 25		29	0	3	plane
	21:40 - 45		47	0	2	plane
6°hour	22:00 - 05		45	0	4	
	22:05 - 10		34	0	4	plane
	22:25 - 30		21	0	3	
	22:45 - 50		26	0	3	voices

TOT Roars 564 0
TOT Deer 6

29-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:33
Weather rain

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		21	0	3	
	17:20 - 25		16	0	2	
	17:40 - 45		18	0	4	Plane
2°hour	18:00 - 05		8	0	2	
	18:05 - 10		17	0	3	Plane
	18:25 - 30		20	0	4	Plane
	18:45 - 50		14	0	2	Plane
3° hour	19:05 - 10		2	0	1	
	19:10 - 15		21	0	4	Plane
	19:30 - 35		13	0	3	Plane
	19:50 - 55		27	0	2	
4°hour	20:10 - 15		16	0	3	
	20:15 - 20		5	0	2	Plane
	20:35 - 40		9	0	3	
	20:55 - 00		43	0	2	
5°hour	21:00 - 05		44	0	2	
	21:20 - 25		0	0	0	
	21:40 - 45		11	0	2	Plane
6°hour	22:00 - 05		23	0	3	
	22:05 - 10		17	1	2	
	22:25 - 30		2	0	2	
	22:45 - 50		3	0	2	

TOT Roars	350	1
TOT Deer	4	

30-Sep-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:32
Weather rain

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		5	0	1	
	17:20 - 25		3	0	1	
	17:40 - 45		18	0	2	
2° hour	18:00 - 05		3	0	1	
	18:05 - 10		9	0	1	
	18:25 - 30		3	0	1	
	18:45 - 50		18	0	2	Car
3° hour	19:05 - 10		15	0	3	Plane/Car
	19:10 - 15		32	0	3	
	19:30 - 35		12	0	3	Plane
	19:50 - 55		13	0	3	
4°hour	20:10 - 15		7	0	2	
	20:15 - 20		3	0	1	Plane
	20:35 - 40		4	0	2	
	20:55 - 00		4	0	1	
5°hour	21:00 - 05		3	0	1	
	21:20 - 25		21	0	3	
	21:40 - 45		21	0	3	
6°hour	22:00 - 05		19	0	2	
	22:05 - 10		11	0	2	
	22:25 - 30		5	0	1	Plane
	22:45 - 50		10	0	2	

TOT Roars 239 0
TOT Deer 4

01-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:30
Weather n.a

			N.Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		17	0	3	Plane
	17:20 - 25		6	0	2	Plane
	17:40 - 45		9	0	2	
2° hour	18:00 - 05		13	0	3	
	18:05 - 10		9	0	2	
	18:25 - 30		23	0	4	Plane
	18:45 - 50		3	0	3	
3° hour	19:05 - 10		29	0	4	Plane
	19:10 - 15		40	0	5	
	19:30 - 35		52	0	4	Plane
	19:50 - 55		33	0	3	
4°hour	20:10 - 15		57	0	5	Plane
	20:15 - 20		38	0	5	Plane
	20:35 - 40		37	0	5	
	20:55 - 00		8	0	2	
5°hour	21:00 - 05		16	0	3	
	21:20 - 25		37	0	6	
	21:40 - 45		24	0	4	
6°hour	22:00 - 05		46	0	6	
	22:05 - 10		57	0	6	
	22:25 - 30		40	0	5	Car
	22:45 - 50		76	0	6	

TOT Roars 670 0
TOT Deer 7

02-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:28
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		9	0	4	
	17:20 - 25		24	1	5	Helicopt.
	17:40 - 45		32	0	6	Plane
2° hour	18:00 - 05		21	0	5	
	18:05 - 10		27	0	4	Voices
	18:25 - 30		47	0	6	Car/Voice
	18:45 - 50		40	1	5	
3° hour	19:05 - 10		33	0	5	Harbor
	19:10 - 15		39	0	5	
	19:30 - 35		44	0	5	
	19:50 - 55		64	1	6	
4°hour	20:10 - 15		55	0	6	
	20:15 - 20		48	0	6	
	20:35 - 40		33	1	5	
	20:55 - 00		44	0	6	
5°hour	21:00 - 05		35	0	6	Plane
	21:20 - 25		39	0	6	
	21:40 - 45		37	1	6	
6°hour	22:00 - 05		28	0	5	
	22:05 - 10		25	1	4	
	22:25 - 30		24	0	4	Car
	22:45 - 50		27	2	5	Plane

TOT Roars	775	8
TOT Deer	7	

03-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:26
Weather n.a

			N.Roars	N.Coughs	N Deer	Disturbes
1° hour	17:00 - 05		31	0	3	
	17:20 - 25		16	0	4	Shot
	17:40 - 45		36	1	4	
2° hour	18:00 - 05		39	0	4	
	18:05 - 10		44	0	4	
	18:25 - 30		87	2	4	
	18:45 - 50		53	3	4	
3° hour	19:05 - 10		43	5	3	Plane
	19:10 - 15		52	5	3	
	19:30 - 35		71	2	5	
	19:50 - 55		41	1	5	
4°hour	20:10 - 15		18	0	2	Plane
	20:15 - 20		26	0	4	Plane
	20:35 - 40		40	2	4	
	20:55 - 00		28	0	4	Plane
5°hour	21:00 - 05		32	2	4	
	21:20 - 25		52	5	5	
	21:40 - 45		27	1	4	
6°hour	22:00 - 05		32	1	4	
	22:05 - 10		23	1	3	Ambulan.
	22:25 - 30		23	0	3	
	22:45 - 50		3	0	2	

TOT Roars 817 31
TOT Deer 6

04-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:24
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		12	0	2	
	17:20 - 25		25	3	5	ambulan.
	17:40 - 45		34	0	4	
2° hour	18:00 - 05		42	1	3	Plane
	18:05 - 10		33	1	5	Plane
	18:25 - 30		37	1	5	
	18:45 - 50		41	1	5	
3° hour	19:05 - 10		49	0	5	
	19:10 - 15		27	1	4	
	19:30 - 35		27	0	5	
	19:50 - 55		42	1	4	
4°hour	20:10 - 15		27	0	4	Plane
	20:15 - 20		31	0	5	Plane
	20:35 - 40		47	0	5	
	20:55 - 00		22	0	4	
5°hour	21:00 - 05		16	0	1	
	21:20 - 25		29	0	2	
	21:40 - 45		40	3	3	
6°hour	22:00 - 05		33	1	4	Plane
	22:05 - 10		23	0	4	Plane
	22:25 - 30		31	0	4	
	22:45 - 50		35	0	4	

TOT Roars 703 13
TOT Deer 5

05-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:22
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		44	0	2	
	17:20 - 25		62	1	5	
	17:40 - 45		52	0	4	
2° hour	18:00 - 05		39	1	3	
	18:05 - 10		28	0	5	
	18:25 - 30		16	0	5	
	18:45 - 50		38	0	5	
3° hour	19:05 - 10		14	0	5	
	19:10 - 15		13	0	4	
	19:30 - 35		27	1	5	
	19:50 - 55		8	0	4	
4°hour	20:10 - 15		13	0	4	
	20:15 - 20		6	0	5	
	20:35 - 40		2	0	5	
	20:55 - 00		18	0	4	
5°hour	21:00 - 05		12	0	1	
	21:20 - 25		14	0	2	
	21:40 - 45		9	0	3	
6°hour	22:00 - 05		26	1	4	
	22:05 - 10		49	0	4	
	22:25 - 30		6	0	4	
	22:45 - 50		23	0	4	Town

TOT Roars 519 4
TOT Deer 5

06-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:20
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		2	1	1	
	17:20 - 25		13	0	4	
	17:40 - 45		11	0	4	
2° hour	18:00 - 05		13	0	3	
	18:05 - 10		12	1	3	
	18:25 - 30		4	0	1	
	18:45 - 50		8	0	2	
3° hour	19:05 - 10		15	0	2	
	19:10 - 15		4	0	2	
	19:30 - 35		18	1	3	
	19:50 - 55		6	0	2	
4°hour	20:10 - 15		17	1	2	
	20:15 - 20		9	1	2	
	20:35 - 40		5	0	2	Plane
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		0	0	0	
	21:20 - 25		0	0	0	
	21:40 - 45		2	0	1	
6°hour	22:00 - 05		2	0	1	
	22:05 - 10		0	0	0	
	22:25 - 30		17	2	2	
	22:45 - 50		7	0	1	

TOT Roars 165 7
TOT Deer 4

07-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:18
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		9	0	2	
	17:20 - 25		4	0	1	
	17:40 - 45		3	0	1	
2° hour	18:00 - 05		7	0	2	
	18:05 - 10		2	0	1	
	18:25 - 30		1	0	1	
	18:45 - 50		8	0	1	
3° hour	19:05 - 10		6	0	2	
	19:10 - 15		1	0	1	
	19:30 - 35		16	0	2	
	19:50 - 55		7	0	1	
4°hour	20:10 - 15		47	1	3	
	20:15 - 20		17	0	2	
	20:35 - 40		26	0	3	
	20:55 - 00		5	1	3	
5°hour	21:00 - 05		24	1	2	
	21:20 - 25		23	0	4	
	21:40 - 45		6	0	1	
6°hour	22:00 - 05		10	0	2	
	22:05 - 10		28	0	3	
	22:25 - 30		10	0	2	
	22:45 - 50		12	0	2	

TOT Roars 272 3
TOT Deer 4

08-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:17
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		4	0	1	
	17:20 - 25		27	1	3	
	17:40 - 45		9	0	3	
2° hour	18:00 - 05		8	0	2	
	18:05 - 10		14	0	3	
	18:25 - 30		16	0	4	
	18:45 - 50		19	0	3	
3° hour	19:05 - 10		10	0	4	
	19:10 - 15		11	0	4	
	19:30 - 35		10	0	2	
	19:50 - 55		3	0	1	
4°hour	20:10 - 15		0	0	0	
	20:15 - 20		0	0	0	
	20:35 - 40		5	0	1	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		0	0	0	Bells
	21:20 - 25		9	0	2	
	21:40 - 45		6	1	1	
6°hour	22:00 - 05		6	0	2	
	22:05 - 10		9	0	2	
	22:25 - 30		14	0	3	
	22:45 - 50		10	0	2	

TOT Roars 190 2
TOT Deer 4

09-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:15
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		15	0	3	
	17:20 - 25		10	0	4	
	17:40 - 45		21	1	3	
2° hour	18:00 - 05		5	0	2	Plane
	18:05 - 10		4	0	2	
	18:25 - 30		4	0	2	
	18:45 - 50		11	0	2	
3° hour	19:05 - 10		15	0	4	Plane
	19:10 - 15		33	2	5	
	19:30 - 35		3	3	2	Plane
	19:50 - 55		19	0	3	
4°hour	20:10 - 15		6	1	2	
	20:15 - 20		9	0	3	Plane
	20:35 - 40		10	0	3	
	20:55 - 00		2	0	2	
5°hour	21:00 - 05		7	0	2	
	21:20 - 25		8	0	2	Plane
	21:40 - 45		16	3	3	
6°hour	22:00 - 05		8	1	2	Car
	22:05 - 10		17	0	3	
	22:25 - 30		43	0	4	
	22:45 - 50		25	0	4	

TOT Roars	291	11
TOT Deer	5	

10-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:13
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		5	0	1	
	17:20 - 25		7	0	1	Plane
	17:40 - 45		7	0	3	
2° hour	18:00 - 05		5	0	3	
	18:05 - 10		11	0	4	Car
	18:25 - 30		6	0	3	
	18:45 - 50		3	0	3	
3° hour	19:05 - 10		10	0	2	Plane
	19:10 - 15		14	0	3	
	19:30 - 35		0	0	0	Harbor
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		1	0	1	
	20:15 - 20		2	0	1	
	20:35 - 40		1	0	1	Car
	20:55 - 00		1	0	1	
5°hour	21:00 - 05		8	0	2	
	21:20 - 25		0	0	0	
	21:40 - 45		1	0	1	
6°hour	22:00 - 05		0	0	0	
	22:05 - 10		9	0	1	
	22:25 - 30		6	0	1	
	22:45 - 50		5	0	2	Plane

TOT Roars 102 0
TOT Deer 4

11-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:11
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		4	0	1	Plane
	17:20 - 25		7	0	2	
	17:40 - 45		7	0	2	
2° hour	18:00 - 05		4	0	1	
	18:05 - 10		6	0	1	Plane
	18:25 - 30		3	0	2	
	18:45 - 50		21	0	3	Plane
3° hour	19:05 - 10		14	0	2	
	19:10 - 15		21	0	4	Plane
	19:30 - 35		2	0	1	
	19:50 - 55		8	0	1	
4°hour	20:10 - 15		5	1	1	
	20:15 - 20		5	0	2	Car
	20:35 - 40		14	0	3	
	20:55 - 00		12	0	3	
5°hour	21:00 - 05		9	0	3	
	21:20 - 25		4	0	2	Plane
	21:40 - 45		5	0	2	
6°hour	22:00 - 05		12	0	2	Plane
	22:05 - 10		9	0	3	
	22:25 - 30		5	0	2	Plane
	22:45 - 50		9	0	2	

TOT Roars 186 1
TOT Deer 4

12-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:09
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		5	0	1	
	17:20 - 25		24	0	3	
	17:40 - 45		6	0	2	
2° hour	18:00 - 05		16	0	3	Voices
	18:05 - 10		12	0	3	Plane
	18:25 - 30		8	0	2	Plane
	18:45 - 50		6	0	3	
3° hour	19:05 - 10		6	0	2	Plane
	19:10 - 15		8	0	1	
	19:30 - 35		7	0	4	
	19:50 - 55		0	0	0	Plane
4°hour	20:10 - 15		8	0	3	Plane
	20:15 - 20		16	0	3	
	20:35 - 40		2	0	1	
	20:55 - 00		9	0	1	Plane
5°hour	21:00 - 05		14	0	2	
	21:20 - 25		4	0	1	
	21:40 - 45		4	0	3	
6°hour	22:00 - 05		4	0	2	
	22:05 - 10		20	0	5	
	22:25 - 30		20	1	3	Plane
	22:45 - 50		12	0	2	

TOT Roars 211 1
TOT Deer 5

13-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:08
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		5	0	2	Helicopt.
	17:40 - 45		11	0	2	Plane
2° hour	18:00 - 05		11	1	3	
	18:05 - 10		14	0	3	Plane
	18:25 - 30		38	0	4	
	18:45 - 50		76	4	4	
3° hour	19:05 - 10		39	1	4	
	19:10 - 15		38	3	3	
	19:30 - 35		51	0	3	
	19:50 - 55		31	0	4	Car
4°hour	20:10 - 15		14	0	2	
	20:15 - 20		21	1	2	Plane
	20:35 - 40		53	0	3	
	20:55 - 00		29	0	4	
5°hour	21:00 - 05		17	0	4	
	21:20 - 25		14	1	4	
	21:40 - 45		22	0	5	Moto
6°hour	22:00 - 05		9	0	3	
	22:05 - 10		19	1	3	Plane
	22:25 - 30		14	0	4	
	22:45 - 50		18	2	3	ambulan.

TOT Roars	544	13
TOT Deer	6	

14-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:06
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		23	0	4	
	17:20 - 25		5	0	3	
	17:40 - 45		4	0	1	Plane
2° hour	18:00 - 05		25	0	4	Plane
	18:05 - 10		27	0	4	
	18:25 - 30		12	0	4	
	18:45 - 50		35	2	4	Plane
3° hour	19:05 - 10		19	0	4	
	19:10 - 15		22	1	3	
	19:30 - 35		20	0	4	Moto
	19:50 - 55		19	1	4	
4°hour	20:10 - 15		5	0	3	
	20:15 - 20		0	0	0	
	20:35 - 40		12	0	4	
	20:55 - 00		14	0	2	
5°hour	21:00 - 05		5	0	2	
	21:20 - 25		4	0	2	
	21:40 - 45		5	0	2	Plane
6°hour	22:00 - 05		9	0	3	
	22:05 - 10		0	0	0	
	22:25 - 30		2	1	1	
	22:45 - 50		0	0	0	

TOT Roars 267 4
TOT Deer 5

15-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:04
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		3	0	1	
	17:20 - 25		1	0	1	
	17:40 - 45		6	0	2	
2° hour	18:00 - 05		7	0	2	Plane
	18:05 - 10		7	0	2	
	18:25 - 30		6	0	2	
	18:45 - 50		4	0	3	
3° hour	19:05 - 10		34	0	2	Plane
	19:10 - 15		8	0	2	Plane
	19:30 - 35		9	1	3	
	19:50 - 55		14	0	2	
4°hour	20:10 - 15		2	0	1	
	20:15 - 20		4	0	1	Plane
	20:35 - 40		0	0	0	
	20:55 - 00		1	0	1	
5°hour	21:00 - 05		1	0	1	
	21:20 - 25		4	0	1	
	21:40 - 45		15	0	2	
6°hour	22:00 - 05		3	0	1	
	22:05 - 10		5	0	0	Plane
	22:25 - 30		1	0	1	
	22:45 - 50		7	0	3	

TOT Roars	142	1
TOT Deer	4	

16-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:03
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		16	0	1	
	17:20 - 25		5	2	1	
	17:40 - 45		9	0	2	
2° hour	18:00 - 05		36	1	3	
	18:05 - 10		34	0	4	
	18:25 - 30		11	0	2	
	18:45 - 50		6	0	2	
3° hour	19:05 - 10		11	0	1	Plane
	19:10 - 15		5	0	2	
	19:30 - 35		6	1	2	
	19:50 - 55		14	0	2	
4°hour	20:10 - 15		3	0	1	Plane
	20:15 - 20		1	0	1	
	20:35 - 40		0	0	0	
	20:55 - 00		17	1	2	
5°hour	21:00 - 05		12	0	2	Car
	21:20 - 25		16	1	4	
	21:40 - 45		18	1	4	Plane
6°hour	22:00 - 05		14	1	3	
	22:05 - 10		8	0	2	
	22:25 - 30		10	0	4	
	22:45 - 50		4	0	1	

TOT Roars	256	8
TOT Deer	4	

17-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 19:01
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		12	1	2	
	17:20 - 25		15	0	2	
	17:40 - 45		30	2	3	
2° hour	18:00 - 05		26	1	4	
	18:05 - 10		23	1	3	
	18:25 - 30		22	0	3	
	18:45 - 50		22	2	4	
3° hour	19:05 - 10		31	0	4	Plane
	19:10 - 15		14	0	2	
	19:30 - 35		24	0	4	
	19:50 - 55		22	0	3	
4°hour	20:10 - 15		10	0	4	
	20:15 - 20		12	0	3	
	20:35 - 40		6	0	3	Plane
	20:55 - 00		23	1	2	
5°hour	21:00 - 05		21	0	2	
	21:20 - 25		10	1	3	
	21:40 - 45		34	1	3	
6°hour	22:00 - 05		23	0	3	
	22:05 - 10		12	1	4	
	22:25 - 30		10	0	1	Plane
	22:45 - 50		9	1	2	

TOT Roars 411 12
TOT Deer 4

18-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:59
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		6	0	2	
	17:20 - 25		16	2	2	
	17:40 - 45		7	2	3	Car
2° hour	18:00 - 05		11	0	4	
	18:05 - 10		40	0	3	
	18:25 - 30		34	0	3	
	18:45 - 50		15	0	4	Car
3° hour	19:05 - 10		27	0	4	
	19:10 - 15		34	0	2	
	19:30 - 35		36	0	4	
	19:50 - 55		10	0	3	Harbor
4°hour	20:10 - 15		3	0	4	
	20:15 - 20		13	0	3	
	20:35 - 40		31	1	3	
	20:55 - 00		23	0	2	
5°hour	21:00 - 05		11	0	2	Plane
	21:20 - 25		12	1	3	
	21:40 - 45		18	1	3	
6°hour	22:00 - 05		15	0	3	
	22:05 - 10		24	0	4	
	22:25 - 30		8	0	1	
	22:45 - 50		10	0	2	

TOT Roars 404 7
TOT Deer 4

19-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:58
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		1	0	1	
	17:20 - 25		3	0	1	
	17:40 - 45		0	0	0	
2° hour	18:00 - 05		5	0	2	
	18:05 - 10		7	0	2	
	18:25 - 30		2	0	1	
	18:45 - 50		10	0	2	
3° hour	19:05 - 10		3	0	2	
	19:10 - 15		3	0	2	
	19:30 - 35		1	0	1	
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		5	0	2	
	20:15 - 20		1	0	1	
	20:35 - 40		7	0	2	
	20:55 - 00		7	0	1	
5°hour	21:00 - 05		4	0	1	
	21:20 - 25		2	1	1	
	21:40 - 45		7	0	2	
6°hour	22:00 - 05		2	0	1	
	22:05 - 10		1	0	1	
	22:25 - 30		1	0	1	
	22:45 - 50		1	0	1	

TOT Roars 73 1
TOT Deer 3

20-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:56
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		2	0	1	Car
	17:20 - 25		5	1	2	
	17:40 - 45		4	0	1	Plane
2° hour	18:00 - 05		1	0	1	
	18:05 - 10		0	0	0	Plane
	18:25 - 30		13	0	2	Plane
	18:45 - 50		31	0	2	
3° hour	19:05 - 10		33	1	2	Plane
	19:10 - 15		12	0	2	
	19:30 - 35		4	0	2	
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		6	0	2	
	20:15 - 20		2	0	1	
	20:35 - 40		3	0	1	
	20:55 - 00		10	1	2	
5°hour	21:00 - 05		3	0	1	Plane
	21:20 - 25		7	1	1	
	21:40 - 45		2	0	1	
6°hour	22:00 - 05		8	1	1	
	22:05 - 10		6	0	2	
	22:25 - 30		13	0	2	
	22:45 - 50		7	0	2	Plane

TOT Roars 172 3
TOT Deer 3

21-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:54
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	Plane
	17:20 - 25		0	0	0	
	17:40 - 45		1	0	1	
2° hour	18:00 - 05		0	0	0	
	18:05 - 10		2	0	1	
	18:25 - 30		2	0	1	
	18:45 - 50		8	0	1	
3° hour	19:05 - 10		7	0	1	
	19:10 - 15		5	0	2	Plane
	19:30 - 35		2	0	1	
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		0	0	0	
	20:15 - 20		0	0	0	
	20:35 - 40		0	0	0	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		3	0	2	
	21:20 - 25		19	0	3	
	21:40 - 45		20	1	2	
6°hour	22:00 - 05		10	0	2	
	22:05 - 10		1	0	1	
	22:25 - 30		30	1	3	
	22:45 - 50		7	1	1	Plane

TOT Roars 117 3
TOT Deer 3

22-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:52
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	Plane
	17:20 - 25		0	0	0	
	17:40 - 45		0	0	0	
2° hour	18:00 - 05		0	0	0	
	18:05 - 10		0	0	0	
	18:25 - 30		0	0	0	
	18:45 - 50		0	0	0	
3° hour	19:05 - 10		0	0	0	Plane
	19:10 - 15		0	0	0	Plane
	19:30 - 35		2	0	1	
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		0	0	0	
	20:15 - 20		1	0	1	
	20:35 - 40		0	0	0	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		0	0	0	
	21:20 - 25		0	0	0	Plane
	21:40 - 45		1	0	1	Plane
6°hour	22:00 - 05		0	0	0	
	22:05 - 10		0	0	0	
	22:25 - 30		0	0	0	
	22:45 - 50		1	0	1	

TOT Roars 5 0
TOT Deer 1

23-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:50
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	Plane
	17:20 - 25		1	0	1	
	17:40 - 45		0	0	1	
2° hour	18:00 - 05		3	0	1	
	18:05 - 10		0	0	0	Car
	18:25 - 30		7	0	1	
	18:45 - 50		1	0	1	
3° hour	19:05 - 10		5	0	1	
	19:10 - 15		5	0	1	Plane
	19:30 - 35		7	0	1	
	19:50 - 55		2	0	0	
4°hour	20:10 - 15		0	0	0	
	20:15 - 20		1	0	1	
	20:35 - 40		5	0	1	Plane
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		2	0	1	
	21:20 - 25		4	0	1	
	21:40 - 45		0	0	0	
6°hour	22:00 - 05		0	0	0	
	22:05 - 10		1	0	1	
	22:25 - 30		0	0	0	
	22:45 - 50		3	0	1	Plane

TOT Roars 47 3
TOT Deer 3

24-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:49
Weather Rain

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		0	0	0	
	17:40 - 45		0	0	0	
2° hour	18:00 - 05		6	0	1	
	18:05 - 10		0	0	0	
	18:25 - 30		4	1	1	
	18:45 - 50		8	1	2	
3° hour	19:05 - 10		2	0	1	
	19:10 - 15		3	0	1	
	19:30 - 35		7	0	1	
	19:50 - 55		4	0	1	
4°hour	20:10 - 15		4	0	1	
	20:15 - 20		3	0	1	
	20:35 - 40		0	0	0	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		0	0	0	
	21:20 - 25		0	0	0	
	21:40 - 45		2	0	1	
6°hour	22:00 - 05		4	0	1	
	22:05 - 10		0	0	0	
	22:25 - 30		0	0	0	
	22:45 - 50		2	0	1	

TOT Roars 49 0
TOT Deer 1

25-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:47
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		1	0	1	
	17:20 - 25		0	0	0	
	17:40 - 45		1	0	1	
2° hour	18:00 - 05		3	0	1	
	18:05 - 10		0	0	0	
	18:25 - 30		0	0	0	
	18:45 - 50		0	0	0	
3° hour	19:05 - 10		0	0	0	
	19:10 - 15		0	0	0	
	19:30 - 35		1	0	1	
	19:50 - 55		2	0	1	
4°hour	20:10 - 15		0	0	0	
	20:15 - 20		1	0	1	
	20:35 - 40		1	0	1	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		2	0	1	
	21:20 - 25		3	0	1	
	21:40 - 45		6	0	1	
6°hour	22:00 - 05		1	0	1	
	22:05 - 10		2	0	1	
	22:25 - 30		0	0	0	
	22:45 - 50		0	0	0	Plane

TOT Roars 24 0
TOT Deer 1

26-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:45
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		0	0	0	moto
	17:40 - 45		1	0	1	moto
2° hour	18:00 - 05		0	0	0	
	18:05 - 10		0	0	0	
	18:25 - 30		0	0	0	car
	18:45 - 50		0	0	0	plane
3° hour	19:05 - 10		8	0	1	plane
	19:10 - 15		10	0	2	plane
	19:30 - 35		3	0	1	
	19:50 - 55		0	0	0	plane
4°hour	20:10 - 15		1	0	1	
	20:15 - 20		2	0	1	
	20:35 - 40		0	0	0	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		0	0	0	
	21:20 - 25		0	0	0	
	21:40 - 45		4	0	1	plane
6°hour	22:00 - 05		1	0	1	
	22:05 - 10		1	0	1	
	22:25 - 30		3	0	1	
	22:45 - 50		2	0	2	

TOT Roars 36 0
TOT Deer 3

27-Oct-13

Starting point 17:00
Ending point 23:00

Astronomical Sunset 18:44
Weather n.a

			N Roars	N Coughs	N Deer	Disturbes
1° hour	17:00 - 05		0	0	0	
	17:20 - 25		0	0	0	
	17:40 - 45		0	0	0	
2° hour	18:00 - 05		0	0	0	
	18:05 - 10		0	0	0	
	18:25 - 30		0	0	0	
	18:45 - 50		0	0	0	
3° hour	19:05 - 10		0	0	0	
	19:10 - 15		0	0	0	
	19:30 - 35		1	0	1	
	19:50 - 55		0	0	0	
4°hour	20:10 - 15		1	0	1	
	20:15 - 20		0	0	0	
	20:35 - 40		0	0	0	
	20:55 - 00		0	0	0	
5°hour	21:00 - 05		1	0	1	
	21:20 - 25		0	0	0	
	21:40 - 45		0	0	0	
6°hour	22:00 - 05		0	0	0	
	22:05 - 10		0	0	0	Plane
	22:25 - 30		0	0	0	
	22:45 - 50		0	0	0	

TOT Roars 3 0
TOT Deer 1

Attachment 2

Day	Tot. Roars	Roars/Hour	Roars/Min	Coughs	Roars/Min listened
17-Sep	0	0	0	0	0
18-Sep	0	0	0	0	0
19-Sep	95	15.833	0.264	0	0.863
20-Sep	213	35.500	0.591	1	1.936
21-Sep	264	44.000	0.733	0	2.4
22-Sep	383	63.833	1.064	2	3,481
23-Sep	773	128.833	2.147	1	7,027
24-Sep	n.a	n.a	n.a	n.a	n.a
25-Sep	297	49.500	0.825	1	2.7
26-Sep	610	101.66	1.694	0	5.545
27-Sep	359	59.833	0.997	0	3.263
28-Sep	564	94.000	1.566	0	5.127
29-Sep	350	58.333	0.972	1	3.181
30-Sep	239	39.833	0.663	0	2.172
01-Oct	670	111.666	1.861	0	6.09
02-Oct	775	129.166	2.152	8	7.045
03-Oct	817	136.166	2.269	31	7.427
04-Oct	703	117.166	1.952	13	6.39
05-Oct	519	86.500	1.441	4	4.718
06-Oct	163	27.166	0.452	7	1.481
07-Oct	272	45.333	0.755	3	2.472
08-Oct	190	31.666	0.527	2	1.727
09-Oct	291	48.500	0.808	11	2.645
10-Oct	102	17.000	0.283	0	0.927
11-Oct	186	31.000	0.516	1	1.69
12-Oct	211	35.166	0.586	1	1.918
13-Oct	544	90.666	1.511	13	4.945
14-Oct	267	44.500	0.741	4	2.427
15-Oct	142	23.666	0.394	1	1.29
16-Oct	256	42.666	0.711	8	2.327
17-Oct	411	68.500	1.141	12	3.736
18-Oct	404	67.333	1.122	7	3.672
19-Oct	73	12.166	0.202	1	0.663
20-Oct	172	28.666	0.477	3	1.563
21-Oct	117	19.500	0.325	3	1.063
22-Oct	5	0.833	0.013	0	0.045
23-Oct	47	7.833	0.130	3	0.427
24-Oct	49	8.166	0.136	0	0.445
25-Oct	24	4.000	0.011	0	0.218
26-Oct	36	6.000	0.016	0	0.327
27-Oct	3	0.500	0.008	0	0.027

Attachment 3

Number of roars counted for the two hours between the astronomical sunset, based on digital data.

Day	Roars 1H before A.S	Roars 1H after A.S
17-Sep	0	0
18-Sep	0	0
19-Sep	12	4
20-Sep	46	53
21-Sep	33	62
22-Sep	46	92
23-Sep	177	130
24-Sep	n.a	n.a
25-Sep	86	40
26-Sep	187	73
27-Sep	57	44
28-Sep	122	87
29-Sep	44	54
30-Sep	70	30
01-Oct	72	180
02-Oct	131	211
03-Oct	218	156
04-Oct	154	127
05-Oct	81	54
06-Oct	31	50
07-Oct	16	80
08-Oct	56	13
09-Oct	63	28
10-Oct	25	8
11-Oct	42	28
12-Oct	21	16
13-Oct	143	135
14-Oct	72	76
15-Oct	24	65
16-Oct	72	36
17-Oct	88	91
18-Oct	100	107
19-Oct	24	7
20-Oct	45	49
21-Oct	12	14
22-Oct	0	2
23-Oct	11	17
24-Oct	16	14
25-Oct	3	1
26-Oct	0	21
27-Oct	0	1

Attachment 4

Number of active deer counted for both methods.

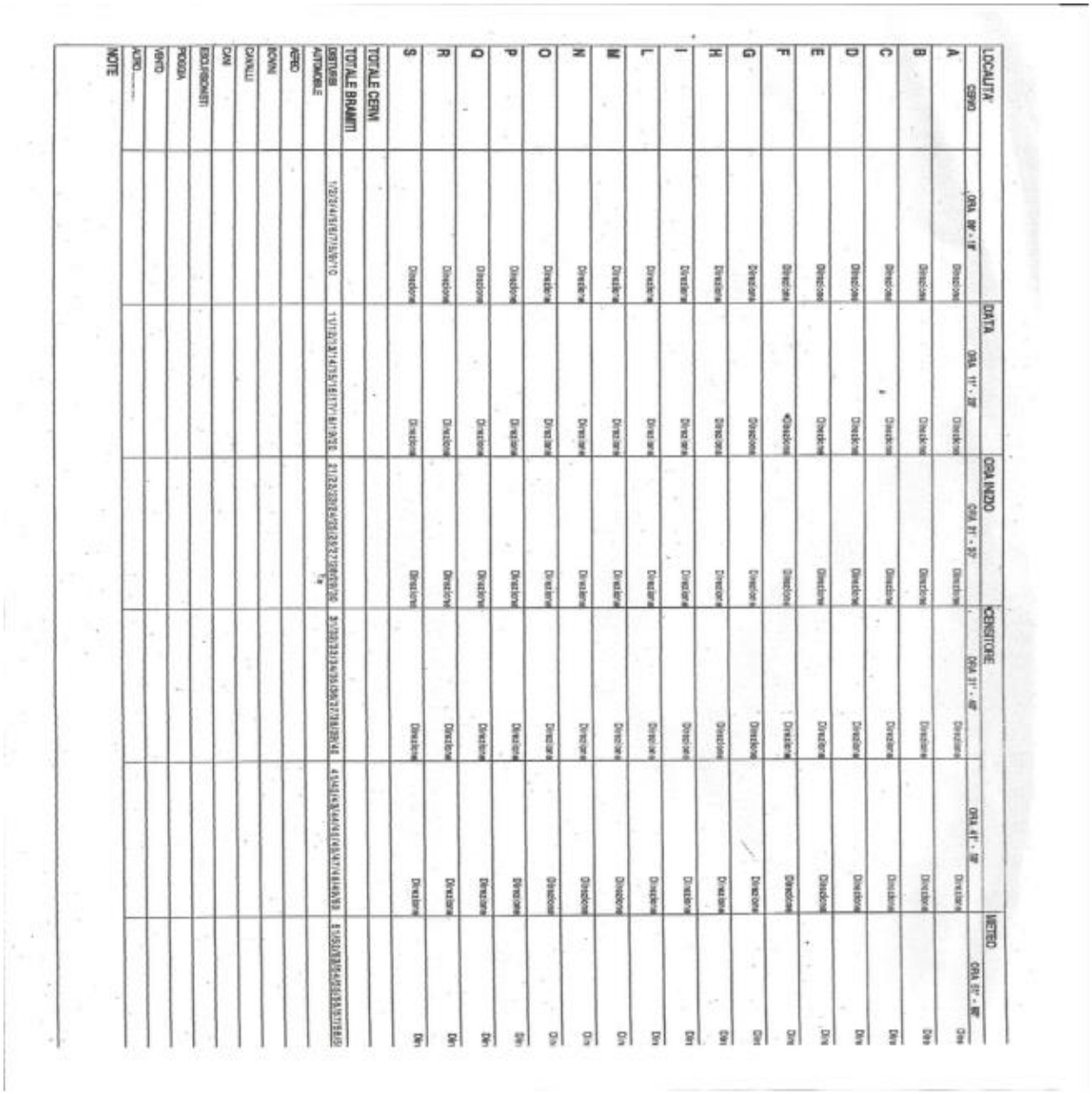
Day	n° deer paper data	n°deer through listening
30/09/2013	8	4
03/10/2013	9	6
09/10/2013	8	5
10/10/2013	6	4
16/10/2013	8	4
22/10/2013	3	1

Attachment 5

Parameters calculated on the basis of paper data.

Day	Roars	N°Deer	Roars/Deer	Roars/Minute Paper	Roars/Minute listened
24/09/2013	334	9	37.111		
30/09/2013	273	8	34.125	1.516	2.172
03/10/2013	1724	9	191.555	9.577	7.427
09/10/2013	506	8	63.250	2.811	2.645
10/10/2013	208	6	34.666	1.155	0.927
16/10/2013	414	8	51.750	2.300	2.327
22/10/2013	72	3	24.000	0.400	0.045

Attachment 6



LOCALITA'	DATA	ORA INIZIO	CENSITORE	METEO
CERVO	ORA 00° - 11°	ORA 11° - 22°	ORA 22° - 00°	ORA 11° - 22°	ORA 22° - 00°
A	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
B	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
C	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
D	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
E	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
F	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
G	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
H	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
I	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
L	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
M	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
N	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
O	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
P	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
Q	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
R	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
S	Direttore	Direttore	Direttore	Direttore	Direttore	Dire
TOTALE CERVI						
TOTALE BRAMITI	1 2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28 29 30	31 32 33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48 49 50	51 52 53 54 55 56 57 58 59 60
DISTURBI AUTOMOBILE						
AEREO						
BOVINI						
CAVALLI						
CANI						
ESCURSIONISTI						
PIOGGIA						
VENTO						
ALTRO						
NOTE						

Attachment n°7

Tabs containing data used for the comparison of listening vs. visual method

1°Sample

day	Interval	Roars (Listening)	Roars (Visual)
23/09/2013	17:40-45	58	49
23/09/2013	18:25-30	86	56
23/09/2013	19:05-10	61	44
26/09/2013	19:30-35	76	78
01/10/2013	22:45-50	76	77
02/10/2013	19:50-55	64	62
03/10/2013	18:25-30	87	89
03/10/2013	19:30-35	71	69
05/10/2013	17:20-25	62	51
13/10/2013	18:45-50	76	64

2°Sample

day	Interval	Roars (Listening)	Roars (Visual)
19/09/2013	22:45-50	0	0
20/09/2013	18:00-50	10	12
22/09/2013	17:20-25	5	3
25/09/2013	20:35-40	8	12
26/09/2013	22:25-30	24	22
27/09/2013	19:05-10	20	21
30/09/2013	17:00-05	5	5
05/09/2013	21:00-05	12	12
06/10/2013	18:25-30	4	4
10/10/2013	19:30-35	0	0