The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK

Animal Welfare 2012, 21(S2): 87-94
doi: 10.7120/09627281 2X13353700593725
ISSN 0962-7286

Welfare during gathering and loading of deer bred for meat in Italy

D Quiliquini*† and I Alpigiani‡

† Consultant, Project Manager Agriconsulting Europe SA, 36 Avenue de Tervueren, B-1040 Etterbeek, Brussels, Belgium
‡ University of Parma, Faculty of Veterinary Medicine, Department of Animal Health, Food Inspection Unit, Via del Taglio, 10- Parma, 43126, Italy
* Contact for correspondence and requests for reprints: d.quiliquini@aesagroup.eu

Abstract

*The aim of this study was to evaluate welfare status and the implementation of Regulation (EC) 1/2005 during the gathering and loading of deer (*Cervus elaphus*) bred for meat in Northern Italy. Four journeys overland along with related operations of 45 deer, destined for game farms, were observed over a period of four months. Planning, animal-management procedures, equipment and facilities, such as enclosures and corridors, influenced the success of the operations and affected the safety of animals and operators. Environmental factors, such as land inclination, were also extremely influential. Elements of the gathering technique led to stress and hyperventilation in a number of animals that were rounded up. Chemical restraint of deer was complicated by consequent physical manipulation and an inability to control withdrawal periods in game reserves. Where facilities were specific to deer, animals displayed no signs of distress and loading was carried out in the absence of stressful behaviour. Instances in which means of transport were non-specific for deer were characterised by falls, escape and trauma during loading and unloading. Where operators had been trained and had extensive knowledge of deer physiology and behaviour, welfare and the safety of professionals were promoted along with an overall regard for the relevant legislation. This study demonstrates a number of the challenges associated with deer transport and related activities. The paucity of specific legislation regarding the management and transport of farmed deer and the absence of European standard procedures have created a lack of harmonisation in transport procedures, ultimately jeopardising the welfare of deer.*

Keywords: *animal welfare, deer, legislation, loading, stress, transport*

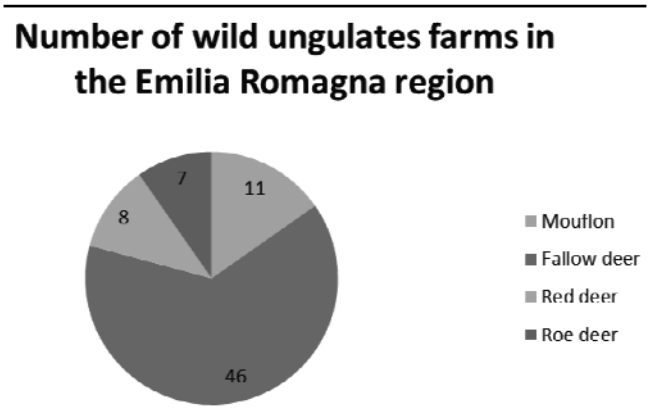
Introduction

Game farms are widespread throughout the world. Red deer (*Cervus elaphus*) are bred on a large scale in New Zealand (Fletcher 2002) as well as in Europe where a survey in 1997 confirmed the presence of 80,000 red deer hinds (females), 20,000 of which can be found in the UK (FEDFA 2007). In Italy, the number of red deer has decreased from 1,600 (Salghetti 1991), located mostly in the regions of Umbria and Toscana, to 1,000 as reported by Carnevali *et al* (2009) and Ramanzin *et al* (2010). This negative trend of the last decades could have occurred as a result of reductions in public subsidies responsible for the success of wild ungulate farming in Italy in the 1980s (FEDFA 2007; Ramanzin *et al* 2010). There are no recently published data available on precise numbers of farmed deer and game farms in Italy. Data provided by Provinces tend not to be updated at regional level and would appear to clearly underestimate the situation locally. It was confirmed, however, by competent local and regional authorities, that the majority of wild ungulate farms are situated in the regions of Emilia Romagna (Figure 1), Umbria and Toscana. Red deer appear to be bred most frequently but fallow deer farms also prevail in the region of Emilia-Romagna and in fenced areas throughout Italy (Carnevali *et al* 2009).

Breeding farms for venison are semi-intensive, and in the second category of the EFSA classification (2006), with free-ranging animals kept in fenced areas with shelters for feeding. Deer bred in semi-intensive farms are not accustomed to human contact which goes some way to explain the stress and flight reaction often observed. According to Weeks (2000), flight distances reduce with familiarity. Thus, knowledge of deer physiology, behaviour and general habitat plays a crucial role in helping reduce the negative impact of human influence during breeding (Mattiello 2009).

In Italy, deer bred for meat are transported to other farms and to game reserves for recreational hunting. They are seldom moved to the rare slaughterhouses authorised for game. In this study, four different examples of gathering and loading techniques are presented with the aim of highlighting challenges faced by the operators in Northern Italy and discrepancies between legislative requirements and their subsequent implementation. The legislation in place, regarding the protection of animals during transport and related operations (Regulation [EC] 1/2005), applies clearly

Figure 1



Distribution of wild ungulates farms in the Emilia Romagna region (Data of Emilia Romagna region 2011).

Figure 2

Facilities for gathering and loading of deer in case studies 1 and 2.

to economic activity associated with deer farming. In the same way, Regulation (EC) 853/2004 states explicitly that it is possible to apply to farmed game the provisions of Section I regarding transport, slaughter, slaughterhouses, game-handling establishments, and hygiene of operations and establishments for domestic ungulates. The Italian Law 157/92 sets out the requirements for the protection of homoeothermic wildlife and for hunting. In addition, each region provides its own regional law, such as LR 8/1994 in Emilia Romagna, which distinguishes between farms according to their aims: whether deer are for re-population, ornamental use or meat production (Piasentier *et al* 2005). This regional law also specifies that farms must be equipped with gathering facilities and limits the destination of the animals to a slaughterhouse or to a similar breeding facility. The transportation of farmed game involves the handling of animals which typically are unaccustomed to such levels of contact. The techniques of gathering and restraint require specific adaption to the species in question and are decided upon by the professionals involved on a case-by-case basis, taking into account: animal density, environmental characteristics, weather conditions, available personnel, experience of the operators and animal welfare implications (Meneguz, personal communication 2011).

In New Zealand, there is a legal effect based on the Animal Welfare Act of 1999, and the Code of Recommendations and Minimum Standards for the Welfare of Animals Transported within New Zealand, enforcing the Code of Welfare for Deer (2007) and applied for transport of deer. However, in Europe, standards on best practices during transport are not in place for these species leading to a lack of harmonisation and an approach based almost wholly on the experience and the subjectivity of the operators. The use of welfare indicators may enable an objective approach to the evaluation of the animal's welfare conditions. These still require to be developed for deer and the objective remains to implement a procedure whereby stress reaches an acceptable level by reducing its intensity or duration.

The aim of this study was to evaluate the animal welfare status and the implementation of Regulation (EC) 1/2005 during the gathering and loading of deer transported for meat in Northern Italy. The four examples demonstrate the challenges faced by operators and the discrepancies between legislative requirements and their implementation.

Materials and methods

The authors participated as observers in the gathering and loading process of four overland transportations of deer bred for meat, without interfering with techniques or procedures. This study was carried out as a research initiative at the Faculty of Veterinary Medicine, University of Parma, Italy and the four cases were selected according to operator availability, geographic location, climatic condition, gathering and restraint techniques used.

Study animals

For this study, 45 deer (ten males, thirty-three females and two fawns), bred in semi-intensive farms, were observed between January and May 2009 during the gathering and loading operations of four overland transportations of less than eight hours in the region of Emilia-Romagna in Italy.

Case studies one and two

The gathering and loading of eight male deer (case study one) and 14 deer (case study two) on a farm for meat production in the Bologna province were observed. Animals were rounded up between 0845 and 1045h in the month of January with an external temperature of approximately 0°C. Feeding enclosures were used to gather part of the herd, consisting of deer of all ages, sizes, and sex. From the enclosure they were restrained physically by a fixed iron facility with corridors and rope-controlled guillotine doors which sectioned the corridor into segments from which selected animals were moved up to loading ramps of vehicles (Figure 2).

In case study one, eight males with and without antlers were loaded onto the two levels of an articulated lorry with semi-trailer, in order to be transported to a meat farm. On the lower level, six males were positioned in individual stalls, while on the higher level, two males with antlers were kept together. The 14 deer of case study two were transferred in a trailer to a wildlife farm in the province of Siena where the male was kept in an individual stall and thirteen females and a fawn shared a compartment.

https://doi.org/10.7120/096272812X13353700593725 Published online by Cambridge University Press

Case study three

In the month of April, seven deer from a meat farm in the province of Reggio Emilia were gathered into a rectangular enclosure surrounded by a fence of discarded barbed wire, no more than 2 m in height. Three out of the seven deer gathered were restrained chemically by a veterinarian between 1310 and 1500h, at an external temperature of approximately 20°C, and one was immobilised physically using direct handling restraint. Following this, deer were loaded onto a trailer authorised for deer, destined for meat-production farm in Province of Parma. The drugs used were combined in the Vienna mix consisting of a 1:1 mixture of Xylazine (Rompun®, Bayer, Milan, Italy) and of Tiletamine-Zolazepam (Zoletil®, Virbac, Milan, Italy) as an injectable solution. The dose of 1.5 ml was administered intramuscularly by darting in adults weighing an average of 200 kg. A dose of 1 ml 100kg^{-1} of the antidote Atipamezole (Antisedan®, Pfizer, Rome, Italy) at 5.0 mg ml^{-1} was administered intramuscularly by the veterinarian inside the vehicle. The three non-captured deer were left in the enclosure. An adult male without antlers and a female were loaded onto the trailer in individual stalls and a young male was loaded along with a female into another compartment.

Case study four

In spring, the loading of 16 deer into an articulated lorry with semi-trailer on a meat farm in the province of Parma took place. Animals were rounded up via a funnel-shaped feeding enclosure located on the farm, and transported by truck to the lairage facility where acclimatisation took place for three days. Loading was carried out through the implementation of physical and manual restraint with fixed corridors and wooden shields which appeared as moving walls with holes to monitor animals. The procedure began at 0930h and took 10 min.

Results

Gathering

In all of the case studies, deer were gathered into an enclosure with the use of feed.

In case study three, the rectangular shape of the enclosure saw the aggregation of deer into corners. The ground was uneven and had a steep incline. Two deer escaped after jumping the low fence (< 2 m in height), with one severely injuring itself. Lacerations were observed in another deer as a result of an unsuccessful attempt at escape.

In case study four, the door of the funnel-shaped feeding enclosure (Figure 3) was rope-controlled, providing limited exposure to the animals.

Restraint

As reported by the operators, restraint techniques were selected on a case-by-case basis by the professionals, taking the available facilities into account, as well as land inclination, the operators' experience and skills in management, the number of animals on the farm and the number of animals to be immobilised.

Figure 3

Feeding enclosure in case study 4.

Figure 4

Mixing of animals grouped in a corner in case studies 1 and 2.

Physical restraint

In case studies one and two, separation of social groups and mixing of deer with/without antlers, males/females and mature/immature animals were observed (Figure 4). The gathered animals displayed anxiety, and a female with perforation of the abdominal area caused by antlers, was euthanised. Fawns were pushed roughly by the adults and a number were trampled, having lost their footing.

Chemical restraint

Case study three involved the darting of subjects which were found to be tachypnoic and hyperventilating. Animals constantly sought to escape and displayed group vigilance (Figure 5). Deer were crushed repeatedly against fences and vocalised. In addition, only four out of the seven animals gathered had been immobilised, provoking nervousness and

Figure 5

Attempt to escape in group in case study 3.

Figure 6

Traumas in throat and chest area and hyperventilation in case study 3

Figure 7

Acclimatisation shed in case study 4.

flight response in the three non-captured animals. Bleeding, lameness and injuries such as lacerations and contusions in the throat and chest area were observed (Figure 6).

In case study four, the gathered deer were transferred via truck from the feeding enclosure to acclimatisation sheds (Figure 7) where they were kept for three days in order to become familiarised with the new group of animals, the feed and the operators.

Transport operations

Means of transport

The two trucks in case studies one and four were authorised for cattle transportation. Anti-slip flooring, strewn with litter, was evident in case study one; there was also a gap between the loading ramp and the floor of the truck. The partitions were home-made, slatted and failed to reach to the ceiling (Figure 8). Ventilation was controlled via the closing/opening of lateral windows. The upper level showed wide lateral openings (Figure 9).

In case studies two and three, a trailer authorised for the transportation of deer and other wild ungulates was used. Window openings created natural ventilation and allowed for observation of animals. However these animals could only be reached through a back door. The floor was covered with a 2.0-cm thick, anti-slip, plastic carpet and partitions reached the full height of the trailer's ceiling (Figure 10).

Loading

In case studies one and two, deer were moved around the restraint facility by an operator who climbed to the top of the structure and brandished a long metallic stick (Figure 11).

Head space in the corridor (Figure 12) was broad enough to allow animals to stand upright. The lateral openings facilitated natural ventilation and the observation of the animals by operators. Sialorrhea was observed in a number of animals (Figure 13).

The escape of a large male through the incomplete and mobile lateral partitions of the loading ramp was reported. Direct handling restraint was observed with deer pulled by its antlers (Figure 14) and lifted by its limbs for loading (Figure 15).

In case study one, a time difference of approximately 30 min between loadings of the two levels of the truck was recorded. The first two males loaded displayed great nervousness and line pacing with hyperventilation, sialorrhea and pupillary dilation.

In case study three, the operators lifted the animals by their limbs and loaded them manually into the trailer (Figure 16).

For case study four, loading operations followed farm protocol whereby animals were led through the corridors to the means of transport in dim light (Figure 17[a]) with the use of their flight zone (Figure 17[b]) and wooden shields (Figure 17[c])

Journey and unloading

Space allowances were not recorded by the authors during the study. The presence of a veterinarian during unloading is required by law only in the event of it exceeding four hours. Thus, no feedback was forthcoming on the health conditions of the deer after transport and unloading. In case

https://doi.org/10.7120/096272812X13353700593725 Published online by Cambridge University Press

study one, the driver informed the veterinarian that one deer had escaped during unloading. In case studies two and three transport procedures were implemented by a veterinarian and animals were loaded successfully. However, it was reported by the veterinarian that the fawn transported along with a restless adult female showed signs of fatigue.

Discussion

Our observation of activities associated with deer transport revealed a number of the challenges faced by operators regarding animal management and the promotion of welfare for deer bred whilst remaining compliant with legislation.

The deer's behaviour during gathering and restraint was influenced by the facilities available and by the shape, inclination and dimensions of the feeding enclosures. In case studies one and two, animals showed clear signs of restlessness and were vigilant after the intervention of the operator. The angle-shaped facility determined the grouping of deer into the corners and complicated the possibility of selecting appropriate animals. In case study four, the animals were rounded up in a funnel-shaped feeding enclosure, which precluded deer from aggregating into corners. This facilitated subsequent loading operations, in which no signs of nervousness were observed, in contrast to case study three where the irregular enclosure shape and the gradient compromised the success of the operators' and veterinarians' activities.

The darting that was carried out in case study three caused hyperventilation, nervousness and fear, and the procedures triggered the aggregation instinct in the animals. Their flight reactions caused chest and throat injuries due to traumatic impact against the fence made of inadequate material. These represented important signs of impaired animal welfare as stated by Mattiello (2009): fear reactions, alteration of social behaviour, modification in feeding, excessive vocalisation, abnormal behaviours, trauma and lesions are direct animal-based indicators and can be considered clear signs of poor welfare. Due to gun malfunction, only three out of seven animals were darted. This resulted in a delay which again caused animals discomfort through prolonged operator contact. An alternative system was recommended in the event of failure. Moreover, the use of sedatives is limited by Regulation (EC) 1/2005, in Annex I Chapter 1 to specific cases "(…) to ensure the welfare of the animals and shall only be used under veterinary supervision". In game reserves, the inability to control the withdrawal periods further limits the use of drugs. Sedation should be reserved for individuals only under specific conditions, to enhance the percentage of success in the rounded-up animal (Meneguz, personal communication 2011).

Acclimatisation in case study four, as referred to in Annex 1, Chapter III of Regulation (EC) 1/2005, allowed a gradual adaptation of animals to the new environment where space was limited and feeding habits were different. Acclimatisation was not performed in the other cases studies due to time constraints and the lack of specific facilities at the farms.

The loading operations observed in the case studies differed according to management, facilities, equipment and means of transport. Loading and unloading increase stress levels

Figure 8

Slatted partitions in case study 1.

Figure 9

Male loaded on upper level in case study 1.

(Waas *et al* 1997) and stress can be reduced if animals are transported in groups of the same age and with social familiarity (Weeks 2000). Mixing, as seen in case studies one and two, contributed to handling stress, increased aggression, as well as physiological indicators of stress (EFSA 2004). Separation of certain categories of animals is required under Annex 1, Chapter 3 of Regulation (EC) 1/2005 to limit trauma and avoidable suffering of the type observed during

Figure 10

Trailer for transport of wild ungulates in case studies 2 and 3.

Figure 11

Human intervention to push the deer through the metallic door leading to the truck in case studies 1 and 2.

Figure 12

Head space and lateral opening in corridor in case studies 1 and 2.

the gathering, loading and transportation of case studies one, two and three.

The manual loading of sedated animals by operators in case study three was not compliant with the legislative requirements of the Transport Practices of Annex I Chapter III of Regulation (EC) 1/2005 where it states that animals cannot be lifted by their limbs. No system was used to move the animals and no appropriate planning was achieved. This represented a serious risk for both operators and animals, exposing them to possible trauma.

In case study four, the use of the flight zone during loading operations enabled operators to proceed quickly and calmly. Darkness played an important role in the success of loading (Blackshaw 1986; Matthews 1993; Weeks 2000; Pollard &Wilson 2002; Mattiello 2009).

Handling facilities need to be designed specifically for deer (Weeks 2000). Specialised handling facilities, such as those employed in case study four, were important for the welfare of deer during gathering and loading as found by Weeks (2000). If the stressors are not repeated, typical handling procedures do not compromise deer welfare (Weeks 2000). Indeed, Matthews (1993) noticed that where appropriate design and construction of deer yards was observed, with walls 2.25 m high to avoid leaping and escape, and no sharp corners, injuries and bruising in deer were reduced. Moreover, Weeks (2000) recommends a height of at least 2 m for fences and 2.5 m for race sides to reduce injury from attempted escape by leaping. In case study one, the lateral partitions of the loading ramp, as required by EU legislation, were considered inadequate for their purpose due to their width, height and mobility and the escape of a male was observed. The means of transport observed in two of the case studies were authorised only for bovines, and therefore not compliant with the technical rule in Annex I of Regulation (EC) 1/2005 but, according to Weeks (2000), vehicles do not necessarily need to be designed specifically for deer. In our experience, the methods of gathering, selecting and loading affected the success of each operation and, thus, animal welfare. The transport vehicles had adequate flooring, but the safety of the animals could not be ensured due to the gap between the loading ramp and the truck's floor, and the upper level of the truck had openings that were not designed, as requested by EU Regulation, so as to prevent the possibility of animals injuring themselves. Furthermore, the EU provisions for access to the animals for inspection during the journey could not be applied in any of the transport operations observed. In case study two, windows allowed visual access to all the compartments. However, during an emergency, animals would not be able to be accessed directly in the front compartments: access was possible only through the back compartments.

In case studies one and two, the operators were not trained to carry out their tasks. No specific procedures were followed. The training of staff on handling is required in article 3 and Annex IV of Regulation (EC) 1/2005 and is considered to be of fundamental importance (Bornett-Gauci *et al* 2006; Mattiello 2009). In particular, aspects related to

https://doi.org/10.7120/096272812X13353700593725 Published online by Cambridge University Press

physiology and behaviour of wild ungulates, their aggregation instinct, their sensory capacities and the genetic and phenotypic differences between wild ungulates should be known by the operators (Mattiello 2009).

The journey and unloading operations could not be observed directly. For this reason, no appropriate conclusions can be drawn regarding this phase of the transportation and very little literature is available.

Animal welfare implications

This study demonstrates the importance of good management practices in the transport and related operations of deer bred for meat. Poor procedures observed in some of the cases in Northern Italy, where operators worked according to their background and experience, gave rise to a non-harmonised approach to operations. The implementation of legislation in place was partially complicated by its lack of specificity in terms of the management and transport of farmed deer. However, this was achieved where there were adequate feeding enclosures, appropriate management and facilities, and planning during the gathering and loading phases.

Conclusion

The results of this study emphasise the challenges faced by farmers regarding the transport of deer and its related operations. The use of appropriate facilities and equipment together with management, operator skills, experience of the veterinarians and careful planning, influence the success of the gathering, restraint, loading and transportation of the animals. However, both animal and environmental variables influenced the duration of the operations, putting at risk the animals' welfare and the safety of operators. It can be concluded that in deer transport, the implementation of the provisions of the EU Regulations present a challenge for operators and veterinarians. Many questions remain unanswered with regards to the use of drugs for immobilisation; the need to use specifically designed facilities to meet the animals' needs; legislative derogations in instances of difficult environmental conditions; and the management of emergency situations.

Further research is recommended to evaluate the transport of deer and related procedures and their impact on the animals after the unloading operations. The development of standard procedures for the transport of deer in Italy or in Europe should be taken into consideration.

Acknowledgements

We thank our dear colleagues who kindly supported us in carrying out our work. In particular, we thank Gianmaria Pisani, Gianni Casalini, Mario Sapino, and the farmers and transporters, who actively collaborated in this study and shared their experience with us, for their assistance.

All the photographs published in this article have been authorised by the involved farmers, transporters and veterinarians.

Figure 13

Sialorrhea in deer in case studies 1 and 2.

Figure 14

Direct manual restraint of deer in case study 1.

Figure 15

Loading of a deer in case study 1.

Figure 16

Lifting of the animal by its limbs in case study 3

Figure 17

Loading through corridors in case study 4

References

Blackshaw JK 1986 Notes on some topics. *Applied Animal Behaviour 3*: 34-40

Bornett-Gauci HLI, Martin JE and Arney DR 2006 The welfare of low-volume farm animals during transport and at slaughter: a review of current knowledge and recommendations for future research. *Animal Welfare 15*: 299-308

Carnevali L, Pedrotti L, Riga F and Toso S 2009 Ungulates database: distribution, abundance, management and hunting of ungulates population in Italy. Report 2001-2005. *Biologia e Conservazione della Fauna 117*: 1-168

EFSA (European Food Safety Authority) 2004 The welfare of animals during transport. *The EFSA Journal 44*: 1-36

EFSA (European Food Safety Authority) 2006 The welfare aspects of the main systems of stunning and killing applied to commercially farmed deer, goats, rabbits, ostriches, ducks, geese and quail. *The EFSA Journal 326*: 1-18

FEDFA 2007 *Deer farming in Italy*. http://www.fedfa.com/index2.html

Fletcher TJ 2002 The domestication and husbandry of deer in tropical regions. *Tropical Agriculture Association Newsletter 22*: 3-7

Law 157/92 1992 Farms and game reserves Legislation of 11 February 1992 on the protection of homeotherm wildlife and on hunting at national level in Italy. *Gazzetta Ufficiale*. http://www.regione.emilia-romagna.it/temi/ambiente/fauna-selvatica-protezione-e-tutela

LR 8/1994 2007 Regional legislation of 15 February 1994 on the protection of wildlife and on hunting. *Official Bulletin of the Emilia-Romagna*. http://www.regione.emilia-romagna.it/temi/agricoltura/caccia/le-norme-e-gli-atti-in-vigore/testo-coordinato-della-legge-regionale-15-febbraio/view

Matthews LR 1993 Deer handling and transport. In: Grandin T (ed) *Livestock Handling and Transport, Third Edition* pp 332-360. CAB International: Wallingford, UK

Mattiello S 2009 Welfare of farmed deer. *Italian Journal of Animal Science 8(1)*: 205-217

Piasentier E, Bovolenta S and Viliani M 2005 Wild ungulate farming systems and product quality. *Veterinary Research Communications 29(2)*: 65-70. http://dx.doi.org/10.1007/s11259-005-0024-2

Pollard JC and Wilson PR 2002 Feature Review Series: health and welfare of farmed deer. *New Zealand Veterinary Journal 50(6)*: 214-220. http://dx.doi.org/10.1080/00480169.2002.36316

Ramanzin M, Amici A, Casoli C, L Esposito, Lupi P, Marsico G, Mattiello S, Olivieri O, Ponzetta M P, Russo C and Trabalza Marinucci M 2010 Meat from wild ungulates: ensuring quality and hygiene of an increasing resource *Italian Journal of Animal Science 9*: 61

Regulation (EC) No 1/2005 2005 Of the 22 December 2004 regulation on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97. *Official Journal Legislation 3*: 1-44. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:003:0001:0044:EN:PDF

Regulation (EC) No 853/2004 2004 The European parliament and the council of 29 April 2004 laying down specific hygiene rules for food of animal origin. *Official Journal Legislation 139*: 55-205. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:139:0055:0205:EN:PDF

Salghetti A 1991 Elementi strutturali ed economici degli allevamenti di ungulati selvatici in Italia. *Annals Of the Faculty of Veterinary Medicine of Parma 11*: 87-156. [Title translation: The structural and economic elements of farmed ungulates bred in Italy]

Waas JR, Ingram JR and Matthews LR 1997 Physiological responses of red deer (*Cervus elaphus*) to conditions experienced during road transport. *Physiology & Behavior 61(6)*: 931-938. http://dx.doi.org/10.1016/S0031-9384(97)00014-0

Weeks CA 2000 Transport of deer: a review with particular relevance to red deer *(Cervus elaphus)*. *Animal Welfare 9*: 63-74

https://doi.org/10.7120/096272812X13353700593725 Published online by Cambridge University Press