

# Transforming wild rabbits' overpopulation problem into a local biotic resource of Lemnos island

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**Abstract** For more than 20 years, the European Wild Rabbit (WR) (*Oryctolagus Cuniculus*) is considered a pest in Lemnos island, Greece, due to significant crop damage. Authorities took insufficient actions to control WR overpopulation, resulting only in managing its effect on crop losses with farmers' compensation. The current study aims to redefine the WR problem in Lemnos by transforming the WR population to a local commodity, where hunting could supply the local market (restaurants and butcheries) with WR products. Semi-structured qualitative interviews from local stakeholders were analyzed using content analysis, to identify their priorities on the WR problem. Additionally, relative local press articles (2005-2023) were recorded and analyzed qualitatively. Furthermore, European and National legal framework was studied to understand the implementation of hunting and selling procedures of WR in local markets. The main events' timeline of the WR overpopulation problem was identified and the stakeholders' key points were combined to create a viable solution. These highlights include the affected areas of interest, hunting processes, and local interest in the supply and demand of WR consumption. The national legislation on hunting and selling of WR at the local market was identified, and its activation is proposed for turning the WR into a sustainable product of local gastronomy.

**Keywords:** *Oryctolagus cuniculus*, Lemnos, sustainable development, hunting, local gastronomy

## 1. Introduction

Invasive alien species are considered as the second largest threat to biodiversity with an estimated annual cost of over US\$300 billion (Luque et al., 2014). The European Wild Rabbit (*Oryctolagus cuniculus*) is one of the invasive alien mammals that cause that significant economic loss (Wang et al., 2023) and was listed as one of the 100 "World's Worst Invasive Alien Species" (Kontsiotis et al., 2015; Simberloff & Rejmanek, 2019). On the other hand, this resilient and

adaptive species is considered as endangered (Marín-García & Llobat, 2021).

In Lemnos island, WR were likely introduced by the Phoenicians and/or Romans (Kontsiotis et al., 2014). However, there is a significant increase of their population due to economic and social reasons, such as the abandonment of farmland in numerous rural areas and the expansion of tourism (Vasios et al., 2020). This increase has been characterized as a plague affecting the biodiversity, ecosystems and crops of the island (Psiroukis et al., 2021). In comparison to other continental and insular habitats, the island of Lemnos exhibits three key differences: the absence of viral infections, the relatively low levels of predation pressure, and the lack of any efficient management plans for WRs (Kontsiotis et al., 2013).

The repeated pressures to the local agricultural community led the Hellenic Organization of Agricultural Insurances (ELGA) to launch a compensation program for WR damage to crops (Table 1). For the period from 2011 to 2021, an agricultural area of 198,166 stremmata was compensated with the total amount of 5,431,775 euros.

**Table 1.** ELGA Compensations from 2011-2021 (Data acquisition from ELGA).

Year	Area of agricultural land (stremma)	Amount of compensation (euro)
2011	12,407	343,541
2012	16,950	343,188
2013	14,658	431,099
2014	19,285	640,043
2015	20,462	580,280
2016	24,170	514,540
2017	20,866	474,330
2018	10,433	275,412
2019	16,791	502,206
2020	19,217	644,448
2021	22,928	682,688
<b>Total</b>	<b>198,166</b>	<b>5,431,775</b>

### 2.3. Digital Press Analysis

Apart from the compensations, various management practices have been tested to control WR overpopulation, such as systematic hunting, warren ripping, fumigation, introducing small number of predators, and illegal poisoning (Saunders et al., 2010; Williams et al., 1995). Despite the considerable efforts made by the state to control the WR population in Lemnos the amount of compensations reached a peak in 2021 (Table 1) suggesting that the overpopulation of WR is well established in the rural areas of Lemnos.

In European Union, European Council has enacted multiple Regulations (178/2002, 852/2004, 853/2004, 854/2004) about the certification for wild game meat, specifying certain requirements, such as the interval between the animal's death and exenteration and the quick transit to specialized facilities for quality standards (Fantechi et al., 2022). Alongside with the regulatory ruling on hunting that is defined annually, a legal framework is established that gives the opportunity of direct supply of wild game meat to the final consumer or local retail establishments (e.g. butchers, restaurants). This framework could increase consumers' consumption of WR meat as an alternative to other meat products, consumed as part of the local gastronomy or as processed food product available in the local market (Petracci et al., 2018; Petracci & Cavani, 2013).

The current study analyzes the WR problem in Lemnos by transforming the WR population to a local commodity, where hunting could supply the local market (restaurants and butcheries) with WR products.

## 2. Methods

### 2.1. Study Area

Lemnos (or Limnos) island is located in the North Aegean Sea in the Prefecture of Lesvos and covers an area of 482 km<sup>2</sup> (Papageorgiou et al., 2020). The main island has low hills and gentle topography (Panitsa et al., 2003). The majority of the land is arable, with the main crops being barley, wheat, triticale, oats, legumes such cowpeas, maize, sorghum, and sesame are less frequent (Bergmeier et al., 2021).

### 2.2. Semi-structured interviews

Seven stakeholders of the local community participated in semi-structured interviews. The interviews revealed twelve central themes as the main thematic areas about stakeholders' perceptions regarding the WR overpopulation: (1) WR and local community, (2) affected areas, (3) applied measures and relevant legislation (4) myxomatosis, (5) impacts of overpopulation (6) hunting, (7) purchase and buy of WR, (8) WR as a product, (9) prevailing situation, (10) WR and COVID-19, (11) suggestions about WR management and (12) information about WR behavior.

An established qualitative content analysis of articles of the local press that were published online was performed (Karlsson & Sjøvaag, 2016). The World Wide Web was searched for articles written in Greek media between 2005 and 2023 using the terms 'wild rabbits', or '*Oryctolagus cuniculus*', and 'Lemnos'. All articles were downloaded from the websites and the information were analyzed and categorized in variables in an Excel table using the same coding as in the semi-structured interviews.

## 3. Results and Discussion

### 3.1. Timeline of events

We identified the main events' timeline of the WR overpopulation problem, taking under consideration the scientific literature, the semi-structured interviews and the digital press (Figure 1). The events were divided in three major periods:

- Period A: (1980-1995) Non-existence of a problem.
- Period B: (1996-2009) Identification of the problem Implementation of repressive and intervention measures.
- Period C: (2010-2023) Application of compensation measures.

During the 1980s the inhabitants of the island were in a relationship of harmonious coexistence with the existing WR population as described. The first occurrence of an increase in their population level and their unwanted activity in crops causing damage and damage to farmers' crops occurred in 1995. Since then, the number of WRs has followed an upward trend, as the damage caused has increased proportionally. Until the year 1999 the presence of WR in the fields has acquired a very negative connotation and is characterized as a 'plague' by the inhabitants of the island. In 2003, the damage to the cereal production of the farmers is estimated to have reached a remarkably high percentage of 80%. The already difficult situation shows no sign of improvement for the farmers. On the contrary, the following period is particularly critical, as there is a constant escalation of the problems caused by WRs, peaking in 2005, leading to practices such as the introduction of predators to the ecosystem and protests.

During the period 2007-2017 and for specific years, the operation of WR hunting crews by night was established, under the supervision of a public official mainly from the forestry administration. Until 2009, the population of WRs seems to have increased rapidly. This fact proves that the control measures for WRs that were in place did not produce the expected outcomes. After various requests made the previous years for compensation of the damage caused to farmers due to the rapid increase in WR population, since 2010, they have become a priority as an insurance risk covered by Hellenic Agricultural Insurance Organization (ELGA). However, in recent years the damage they cause to the

island's crops has increased to such an extent that inevitably there were strong protests from local authorities and farmers. In 2011, the myxomatosis disease appeared, with the causes of the disease not yet established. The existence of the disease in individuals of the WR population of Lemnos was confirmed by public authorities, following an assignment by the Greek Ministry of Rural Development and Food. Myxomatosis is a disease to which the European WR species is highly susceptible (Bartrip, 2008). During the same year, a notice is published by the Department of Veterinary Medicine of the Regional Unit of Lemnos, declaring the meat of rabbits infected with the disease as unfit for human consumption, according to the EC Regulation 853/2004. At the same time, farmers and hunters of Lemnos demanded the need for more efficient and permanent solutions so that ecological balance of the food chain could be achieved again. However, the problems created by the overpopulation of WRs in Lemnos have multiplied in recent years, while the measures taken by the Ministry of Rural Development have not been able to reduce them.

Throughout period C, the reduced interest in hunting, alongside with compensations, and the local climatic conditions acted in favor of the WR. The prohibition of hunting for long periods of time, combined with the reduced disturbance of WR from other anthropogenic activities during the lockdown period of the COVID-19 pandemic, allowed the occurrence of WRs even in residential areas of the island, for example in the settlement of Sardes.

### 3.2. WR as a sustainable biotic resource

Lemnos island is highlighted as a culinary destination due to its unique topography and local high quality food products. WR as a dish has a place in the local gastronomic heritage as it appears in traditional recipes cooked by the locals or served in some restaurants in the island. It was a common option for households with low income. Currently, it is undervalued as a meat product because of its abundance, despite its high nutritional value. Additionally, hunters consider WR as an easy prey and have lost their interest in hunting it. The reduced interest and the difficulties in handling the WR meat discourages local catering businesses to incorporate it as a product.

However, the hygiene requirements for ensuring the safety of foodstuffs, including wild game meat, are set out in the following EU Regulations: 178/2002, 852/2004 and 853/2004. Guidance about the legal requirements that apply in the various circumstances in which WR is hunted and supplied for human consumption (handling, inspection, storage, transport and processing of wild game meat for human consumption) is required both for health and economic reasons. Furthermore, the current annual regulatory ruling on hunting in Greece facilitates the conduct of hunting of WR and the sale of its meat because of WR overpopulation.

Taking under consideration both European and National legal framework, chain of supply and demand of WR

consumption could be created turning WR from a pest to into a sustainable product of local gastronomy.

## 4. Conclusion

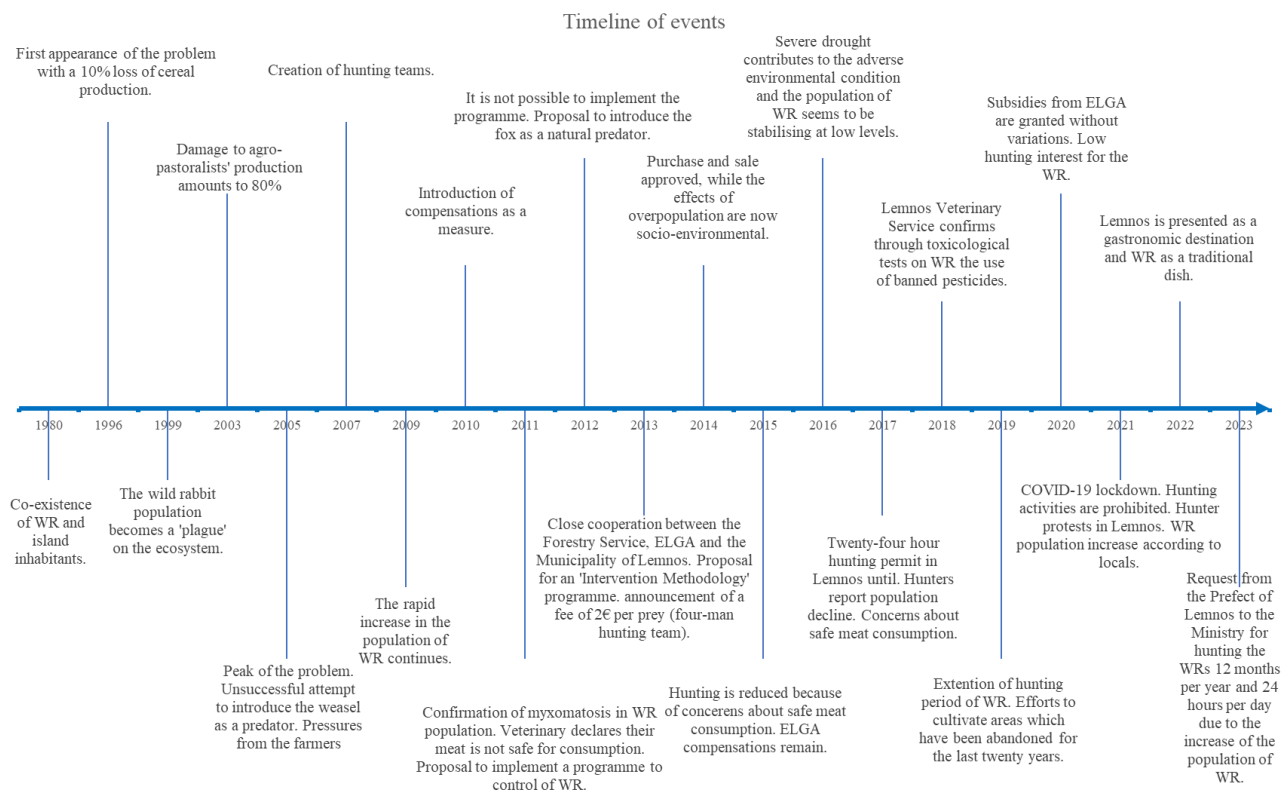
This research focused on local actors and digital press to redefine the WR overabundance issue. The findings demonstrate that the WR overpopulation problem could be transformed from a cause of huge economic loss to a sustainable biotic resource with potential economic benefits for the locals.

The exploitation of the existing legislative framework alongside with the promotion of Lemnos as a gastronomic tourist destination, support the idea of the commercial exploitation of the WR through a feasible management approach. This objective calls for a combination of integrated management strategies on a regional and institutional level, but more crucially, it calls for an organized information campaign for the local entrepreneurs.

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**Figure 1.** Timeline of events concerning WR in the island of Lemnos. Recording and categorization in three time periods (1980-1995, 1996-2009, 2010-2023) of the most important events as identified from the digital press review, interviews and literature.

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