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## **Prevalence of tick species in sheep and goat flocks in areas of southern Greece**

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## **Συχνότητα παρασιτισμού από κρότωνα σε κοπάδια προβάτων και αιγών περιοχών της νότιας Ελλάδας**

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**ABSTRACT.** The purpose of this study was to investigate the tick prevalence and to identify the species of ticks that parasitise the small ruminant flocks in the prefectures of Achaia (in the geographic region of Peloponnese) and Chania (in the island of Crete). Thirty flocks of goats and sheep were examined for tick parasitism during the period from December 2012 until August 2013. Sixteen of them were in Achaia and the rest 14 in Chania. In total, 84 goats and 148 sheep were examined; from them, 50 goats and 70 sheep in Achaia, and 34 goats and 78 sheep in Chania. The species *Dermacentor marginatus* was identified in Achaia in 15% of the animals. In Chania the species identified were *Haemaphysalis punctata* (13%), *Hyalomma anatolicum* (4.47%), *Rhipicephalus sanguineus* (4.47%) and *Ixodes ricinus* (3.58%). This is the first study on tick infestation in sheep and goats in Peloponnese and Crete, two areas with large number of small ruminant population and important tradition in small ruminant farming.

**Keywords:** sheep, goats, ticks, Peloponnese, Crete

**ΠΕΡΙΛΗΨΗ.** Ο σκοπός αυτής της μελέτης ήταν ο προσδιορισμός της συχνότητας παρασιτισμού από κρότωνα και η ταυτοποίηση των ειδών των κροτώνων σε εκτροφές μικρών μηρυκαστικών στους Νομούς Αχαΐας και Χανίων. Η μελέτη διεξήχθη από τον Δεκέμβριο του 2012 ως τον Αύγουστο του 2013 και περιέλαβε συνολικά 30 εκτροφές μικρών μηρυκαστικών, 16 από το Ν. Αχαΐας και 14 από το Ν. Χανίων. Εξετάστηκαν συνολικά 84 αίγες και 148 πρόβατα. Οι 50 αίγες και τα 70 πρόβατα προέρχονταν από εκτροφές του Ν. Αχαΐας, ενώ τα υπόλοιπα ζώα προέρχονταν από εκτροφές του Ν. Χανίων. Από το Ν. Αχαΐας ταυτοποιήθηκε μόνο ένα είδος κρότωνα, το *Dermacentor marginatus* (15%), ενώ στο Ν. Χανίων βρέθηκαν τα είδη *Haemaphysalis punctata* (13,40%), *Hyalomma anatolicum* (4,47%), *Rhipicephalus sanguineus* (4,47%) και *Ixodes ricinus* (3,58%). Αυτή είναι η πρώτη μελέτη της μόλυνσης από κρότωνα στα μικρά μηρυκαστικά που διεξάγεται στην Πελοπόννησο και την Κρήτη, δύο γεωγραφικές περιοχές με μεγάλη παράδοση στην εκτροφή των μικρών μηρυκαστικών και με μεγάλους πληθυσμούς προβάτων και αιγών.

**Λέξεις ευρετηρίασης:** πρόβατα, αίγες, κρότωνα, Πελοπόννησος, Κρήτη

## INTRODUCTION

Ticks are hematophagous ectoparasites that attach mainly to mammals and birds (Wall and Shearer, 2001). Usually, they parasitise particular body areas such as the head, ears, neck, the inside part of limbs, the abdominal and the perineal region (Haralabidis, 2003). Ticks are separated in two main families: the Argasidae family or soft ticks and the Ixodidae known also as hard ticks (Urquhart et al., 1996; Bowman, 1999; Wall and Searer, 2001; Zajac and Conboy, 2006). However, some researchers support the existence of a third tick family, the Nuttalliellidae which includes only a single species, found in swallow nest in North Africa (Wall and Shearer, 2001). Ticks and especially those of the Ixodidae family are of veterinary importance not only because they cause direct harm to the skin and the tis-

sues of the host, but also because they transmit various pathogens (Urquhart et al., 1996; Hendrix, 1998; Wall and Shearer, 2001).

The studies on ticks of mammals in Greece have been mainly conducted in areas of the Northern country (Papazahariadou et al., 1995; Papadopoulos et al., 1996; Pavlidou et al., 2008; Kachrimanidou et al., 2010; Kachrimanidou et al., 2011) and in a less extend in central and islands of Greece (Psaroulaki et al., 2003; Psaroulaki et al., 2006).

Considering the limited or non-existent information about ticks of small ruminants in many parts of Greece, this study aimed to investigate the prevalence of tick infestation and the species of ticks involved in small ruminant flocks in two areas of southern Greece.

## MATERIALS AND METHODS

### Flocks' location

The study was conducted in two prefectures of southern Greece, i.e. Achaia (in the geographic region of Peloponnese) and Chania (in the island of Crete), that have large small ruminant populations and tradition in their rearing. Achaia prefecture is situated in Peloponnese and its total area is 3,209 km<sup>2</sup>; it is mainly mountainous and has access to the sea. Therefore the number of plains is limited and they are situated only between the mountains and the sea. The climate is mild and only during winter months the temperature may be low (<http://www.hellenica.de/Griechenland/Geo/GR/NomosAchaïas.html>). The total number of sheep and goats reared in Achaia prefecture is about 635,000, out of which about 442,000 are sheep and the rest 193,000 are goats.

On the contrary, the prefecture of Chania is situated in the western part of island Crete, in its north, west and south it is surrounded by sea, its total area is 2,347 km<sup>2</sup> and presents a great geomorphologic variety such as peninsulas, rivers, valleys and mountains. Although the range of Lefka Ori covers a large part of the regional unit of Chania, its valleys are of a large extension, too. The climate of the regional unit is temperate Mediterranean and particularly dry as approximately 70% of the year there is sunshine. The winter is mild and the weather from November until March is cold but not freezing with frequent rainfalls (<http://www.sevach.gr/chaniagr.php?vis=2>). In this prefecture, the total number of sheep and goats which are reared is about 602,000, out of which about 408,000 are sheep and the rest 194,000 are goats.

### Collection of samples

The study started in December 2012 and was completed in August 2013. All the flocks that were included in the study were reared under the semi-intensive feeding system. In particular, during the winter months the animals were kept and fed indoors, while during the rest of the year the animals were grazing in natural grasslands and were fed with supplementary feedstuffs. All the animals of the examined flocks were in good health. The visits to the farms, the clinical examination of the animals and the collection of the samples were conducted early in the morning, before the feeding, in the yard where the animals were kept.

In the prefecture of Chania fourteen flocks were examined in total, i.e. nine sheep flocks, four goat flocks and one mixed flock. Nine of them were receiving treatment once or twice a year against ectoparasites, while the remaining five were not under any treatment against ectoparasites. All the information regarding the flocks in the prefecture of Chania is found in Table 1.

In the prefecture of Achaia sixteen units were examined, i.e. four sheep flocks, eight goat flocks and four mixed flocks. Twelve of these flocks were under antiparasitic treatment against ectoparasites, while four were not under any anti-ectoparasitic treatment. All the information for the flocks in the prefecture of Achaia is found in Table 2.

In both prefectures the samples were collected in the same way. Six randomly selected animals were examined in each flock. In the case that at least one of these animals was infected by at least one tick, the whole flock was considered to be positive. Otherwise, four more animals were examined for the presence of ticks. In the case that ticks were not found in ten samples, the flock was considered to be negative.

The tick collection from each animal followed a standard procedure. The examination started from the head and more precisely the horns (in the case of horned animals) and continued with the ears (external and internal surface), cheeks, the area around the eyes, neck, inside and outside parts of the front limbs, breasts, perineal area and finally, the tail. Ticks from each animal were collected in a vial with alcohol 70%. Ticks were removed by forceps and the collector was wearing latex gloves.

### Tick identification

Tick identification and gender determination was based on the external morphological characteristics of the collected specimens (Baker, 1999; Estrada-Pena et al., 2004). The study of the morphology of the ticks was performed under an optical stereoscope.

## RESULTS

All the examined animals in both prefectures were clinically healthy, while according to the owners and the local veterinarians there had not been detected signs of tick-borne diseases.

In the prefecture of Chania, tick infestation was

found in 5 sheep and 3 goat flocks out of the 14 examined in total. Four of the positive flocks were under antiparasitic treatment and the rest were not, while all the untreated flocks were infested (Table 1). Furthermore, 20 (25.64%) out of the 78 examined sheep and 9 (26.47%) out of the 34 goats were infested by ticks. In total, 59 ticks were collected. All the ticks were adults, 40 males and 19 females. In total, out of the 59 collected ticks, 30 (50.85%) were identified as *Haemaphysalis punctata*, 10 (16.95%) as *Rhipicephalus sanguineus*, 10 (16.95%) as *Ixodes ricinus* and 9 (15.25%) as *Hyalomma anatolyicum* (Table 3). *Haemaphysalis punctata* and *R. sanguineus* were found only in sheep, while *H. anatolyicum* and *I. ricinus* were found only in goats. All collected *H. punctata* and *R. sanguineus* were males, while all *H. anatolyicum* and *I. ricinus* were females (Table 3).

In the prefecture of Achaia, tick infestation was found in 6 goat and 4 mixed flocks out of the 16 examined in total. All the 4 pure sheep flocks were found free of ticks. Seven out of the 10 positive flocks were under antiparasitic treatment, whilst the rest 3 positive flocks did not receive any antiparasitic treatment for ticks and other ectoparasites in the last 6 months. Also, 5 out of the 6 negative flocks were under antiparasitic treatment (Table 2). Two out of 70 examined sheep (4%) and 16 out of 50 examined goats (22.85%) were parasitized by ticks (Table 4). The only tick species that was found during this study in the prefecture of Achaia was *Dermacentor marginatus* (relative abundance 100%) and its prevalence in the flocks level was 15%. Moreover, 37 ticks were counted, out of which the 26 were female and the rest 11 were male (Table 4).

## DISCUSSION

Taking into account the very few studies upon small ruminant parasitism by ticks in Greece, this preliminary study aimed to give some information on the tick status in 2 prefectures of southern Greece.

To date, the relative existing studies in Greece have focused on the selection and identification of ticks from several animal species, including small ruminants. All these studies had been conducted mainly in central and northern Greece (Papazahariadou et al., 1995; Papadopoulos et al., 1996; Psaroulaki et al., 2003; Psaroulaki et al., 2006; Pavlidou et al., 2008; Kahrimanidou et al., 2010; Kahrimanidou et al., 2011). According to the

aforementioned studies, for small ruminants the species *D. marginatus* and *H. punctata* do not represent a high percentage in northern Greece compared to their percentage in the prefectures of Achaia and Chania. On the contrary, in these regions the species with the highest prevalence was *I. ricinus*, (Pavlidou et al., 2008), *I. gibbosus* (Papazahariadou et al., 1995) and *R. bursa* (Papadopoulos et al., 1996). *Rhipicephalus sanguineus* was mainly found in central Greece and *R. turanicus* and *R. bursa* in Fokida and the island of Cephalonia (Psaroulaki et al., 2003; Psaroulaki et al., 2006). Moreover, in the island of Cephalonia also *Hyalomma*, *Dermacentor* and *Haemaphysalis* species were identified in sheep and goat flocks (Psaroulaki et al., 2006).

In southern-east Europe, that has similar climatic conditions with Greece, several studies have also been carried out that offer useful information on the prevailing tick species. For example, in the south regions of the Appenin Mountains in Italy the *Dermacentor marginatus* species is the most frequent with a percentage of 37.6% (Rinaldi et al., 2004), exactly like in the prefecture of Achaia. In Basilicata region (southern Italy) the parasitism of sheep is dominated by *Rhipicephalus* species, but also *D. marginatus*, *I. ricinus* and *Hyalomma* species were found (Rinaldi et al., 2014). Similarly, *Rhipicephalus* species prevailed in sheep a study in Sicily, with the only other species being *H. marginatum* (Torina et al., 2006). In the region of Belgrade the species of *I. ricinus* is the most often appearing tick species in goats and sheep (41.91%), while less prevalent are other species of ticks that were found in the prefectures of Achaia and Chania, like *D. marginatus*, *R. sanguineus* and *H. punctata* (Pavlovic et al., 2012). In Bulgaria a seasonal variation in the tick species that parasitize sheep and goats was demonstrated. The most common was *R. bursa*, while also *R. sanguineus*, *I. ricinus*, *D. marginatus*, *H. sulcata*, *H. punctata* and *Hyalomma plumbeum* were identified (Arnaudov et al., 2014). *Rhipicephalus* species dominated also in a study in Turkey that was conducted in various domestic animals, included sheep and goats (Koc et al., 2015).

Regarding the pathogens that can be transmitted by the tick species found in this study, *D. marginatus*, that was the only species found in Achaia, can transmit to sheep *Babesia ovis*, *Theileria ovis*, *Anaplasma ovis* and *Coxiella burnetii*, while it is also the vector of Russian spring-summer encephalitis virus and the Siberian tick

typhus (Wall and Shearer, 2001). In Chania, the most common tick species was *H. punctata*, that has been found to transmit babesiosis and theileriosis in small ruminants and to cause also tick paralysis; it can also transmit tick borne encephalitis virus, Tribec virus, Bhanja virus, Crimean-Congo haemorrhagic fever virus, *C. burnetii* and *Francisella tularensis* (Urquhart et al., 1996; Wall and Shearer, 2001).

*Rhipicephalus sanguineus*, that was found in sheep of Chania, can transmit Nairobi sheep disease in East Africa (Wall and Shearer, 2001), as well as various pathogens in other animal species and humans (Bowman, 1999). *Ixodes ricinus* can cause tick pyaemia, babesiosis and anaplasmosis in sheep (Wall and Shearer, 2001; Giadinis et al., 2011). *Hyalomma* spp. can

survive exceptionally cold and dry conditions and have been incriminated as vectors of several babesial, theilerial and rickettsial infections (Urquhart et al., 1996).

In conclusion, this preliminary study showed the tick species that parasitize the small ruminant flocks of southern Greece. Taking into account the small sample size, a larger study in wider geographical areas and possibly with concurrent identification of pathogens transmitted by ticks seems to be necessary.

#### CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.



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