



**Integrated ESIA Greece  
Annex 6.5.4 - West - European Souslik Baseline  
Study**

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## 1 INTRODUCTION

### 1.1 General Information on *Spermophilus* Populations in Europe and Greece

The European ground squirrel, *Spermophilus citellus* (Linnaeus, 1766), is a species of the squirrel family Sciuridae, order Rodentia, and it is distinguished in 4 subspecies, *S. c. citellus*, *S. c. gradojevici*, *S. c. isticus* and *S. c. martinoi* (reviewed in Helgen *et al.*, 2009). The species is endemic to central and south-eastern Europe and is considered to be dependent on short-grass open vegetation (Coroiu *et al.*, 2008), where it follows an omnivorous diet including seeds, green plant parts, flowers, insects and roots (Mc Donald & Barrett, 1993). The European ground squirrel, or else souslik, grows to a length of between 19-22 cm and its weight varies between 240 and 340 g. The two sexes mate from March to April (Benhaiem, 2006) and the females give birth to 5-8 cubs (Mc Donald & Barrett, 1993).

The European ground squirrel is an obligate hibernator, thus its annual cycle is characterized by an inactive and active season, when the animals immerse in and emerge from hibernation, respectively. Hibernation season lasts from late summer until late spring, while its duration differs depending on the age and sex: adult females enter first into hibernation, followed by the males and finally by the juveniles. The active season, on the other hand, starts in early spring and, similarly to the hibernation season, is sex and age-dependent: the adult males immerse first, followed by the adult females, and lastly the juveniles of both sexes (Youlatos *et al.*, 2007; Mateju, 2008).

During the active season, the ground squirrel exhibits only diurnal activity (Hutt *et al.*, 1999; Everts *et al.*, 2004) and spends almost half of its time aboveground (Everts *et al.*, 2004, Youlatos *et al.*, 2007). The activity patterns of the species are influenced by the photoperiod (Everts *et al.*, 2004; Koshev & Kosheva, 2008), other climatic factors, such as the temperature, (Youlatos *et al.*, 2007; Koshev & Kosheva, 2008) and the rainfall (Everts *et al.*, 2004), the sex (Boutsis, 2002; Debit, 2003; Everts *et al.*, 2004) and reproductive state (Everts *et al.*, 2004), while the main behaviours the species exhibits are vigilance and feeding (Everts *et al.*, 2004; Youlatos *et al.*, 2007). Other behaviours include mating, preparation of the hibernation by both sexes, while the females also gestate, give birth to juveniles and lactate (Debit, 2003).

The species forms loosely structured populations, known as colonies (Koshev, 2008), which correspond to aggregations of individuals (groups) within the space, which are spatially

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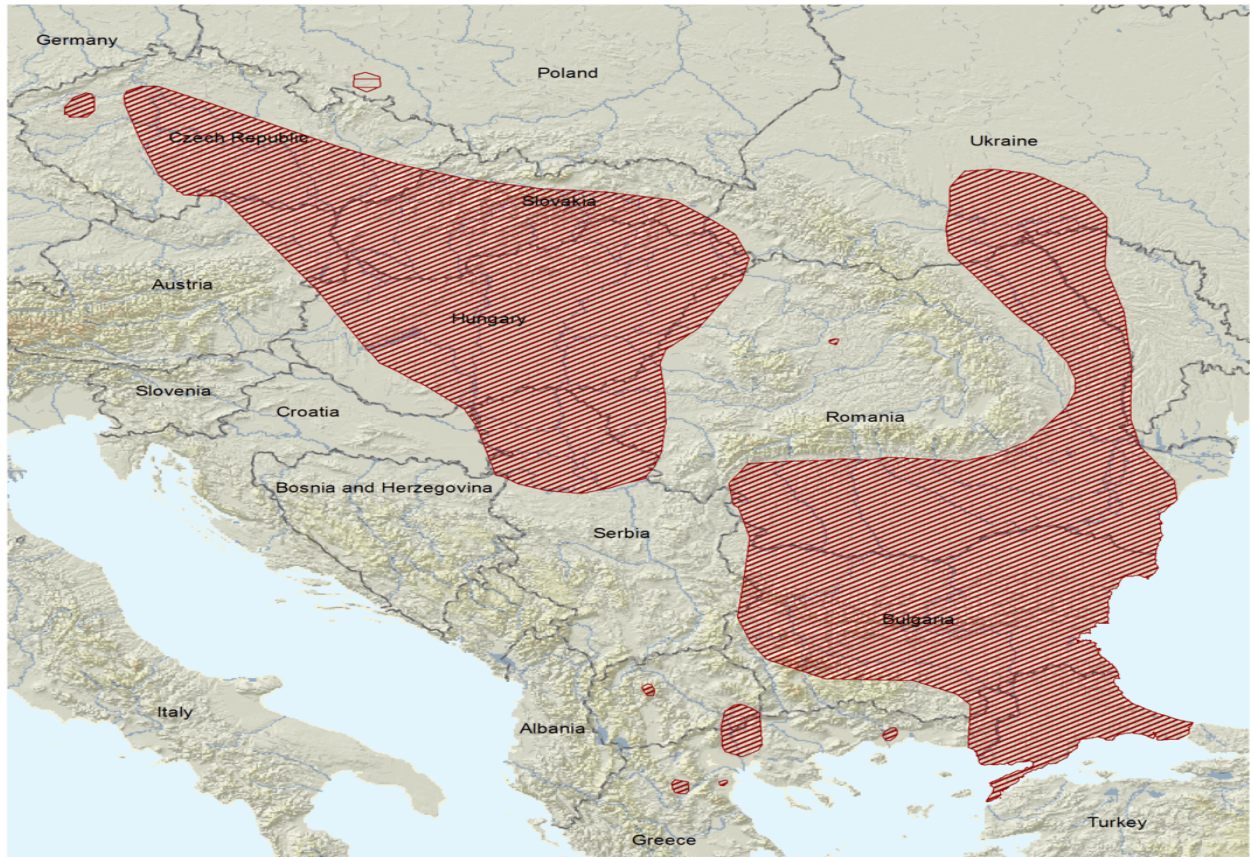
separated from other similar groups inhabiting the same region (Stefanov & Markova, 2009). However, within the colonies social interactions among the animals are rather restricted and each animal constructs and uses its own burrow (Benhaeim, 2006). A single burrow system consists of 1 - 5 (Boutsis, 2002; Ozkurt et al., 2005), or even more surface openings (Mateju, 2008), interconnected via tunnels (reviewed in Boutsis, 2002). Burrows are used for multiple purposes: they provide shelter during the hibernation, while during the active season they are used as resting, sleeping places, as shelters from predators, and as places for food storage and reproduction (reviewed in Gedeon *et al.*, 2010).

The species is endemic to central and south-eastern Europe with its range distinctly divided into two areas by the Carpathian Mountains. The north-western area includes Czech Republic, Austria, Slovakia, Hungary, northern Serbia and Montenegro, and western Romania, while the south-eastern areas extends from southern Serbia, Macedonia and Greece through Bulgaria and southern Romania to Turkish Thrace, Moldova and Ukraine (reviewed in Coroiu *et al.*, 2008) (Fig 1.1). Although widely distributed in Europe, its populations are fragmented and its present range is just a part of a quite larger range the species had in the past. During the middle of the 20th century, European ground squirrel was abundant in Czechoslovakia (Mateju *et al.*, 2010), Bulgaria (Stefanov and Markova, 2009), Austria (Turrini *et al.*, 2008) and Hungary (Váczai et al., 2008). Also, in most of these countries the species was considered as a pest, and, for example in Bulgaria, management measures were taken to limit its numbers (reviewed in Stefanov and Markova, 2009). In the next decades, its natural habitats were significantly deteriorated, the abundance of the species decreased and its distribution became fragmented, while in some countries, such as in Croatia, the species got extinct (reviewed in Coroiu *et al.*, 2008).

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**Figure 1-1 Worldwide Distribution of the European Ground Squirrel**

Source: IUCN (2008)

The species is dependent on short-grass open habitats (Coroiu *et al.*, 2008), and the main reasons of its decline are associated with the change of the agricultural practices and the urbanization. More specifically, the major reasons of its population reduction and its subsequent fragmentation are considered to be the alteration of the meadows and pastures into fields, the absence of management of vegetation cover to a short height and the urbanization (Turrini *et al.*, 2008; Koshev, 2008; Mateju *et al.*, 2008, Uhlíková *et al.*, 2008). On the other hand and quite ironically, at present the species inhabits mainly anthropogenic environments, such as airfields, sport areas, alfalfa cultivations, pastures and far less natural habitats, such as steppe areas (Hoffmann *et al.*, 2008; Mateju *et al.*, 2008).

The species' population status and habitat in each country is as follows:

**Bulgaria:** Although during the period 50s-70s of the past century the European ground squirrel was considered a pest for the agriculture (Stefanov and Markova, 2009), today the species distribution and density have decreased significantly (Koshev, 2008). For these reasons, the

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species is referred to Bulgarian Biological Diversity Act, Appendix II and it is included in the Red Data Book of Bulgaria, as vulnerable (Stefanov and Markova, 2009).

**Austria:** Considered as a pest during the first half of the 20<sup>th</sup> century, the species has experienced a dramatic decrease, and has been listed as endangered since 1984 (Turrini *et al.*, 2008).

**Turkey:** Its distribution is restricted to the steppe areas of Turkish Thrace. Available data for the species are very limited; however it seems that its population is in decline (Ozkurt *et al.*, 2005).

**Czech Republic and Slovakia:** Described as a severe pest in the former Czechoslovakia in the early 1950s, nowadays the species is one of the most threatened mammals in the country, and is listed as a critically endangered species, under the protection of the Act no. 114/1992 Coll. on Nature Conservation and Landscape Protection (Mateju *et al.*, 2008).

**Hungary:** Since the middle of the 20<sup>th</sup> century, the species has suffered a severe reduction in its population size and has disappeared from certain localities in the past few years (Vaczi *et al.*, 2008).

**Germany:** The species became extinct in 1968 (Mateju *et al.*, 2010). In 2006 a reintroduction project was initiated (Coroiu *et al.*, 2008).

**Poland:** The species became extinct in 1983. Within 2000-2004 a reintroduction program was implemented successfully and in 2008 the population size was estimated at 150-200 individuals (Mateju *et al.*, 2010).

**Croatia:** The species became extinct (Coroiu *et al.*, 2008).

**Romania:** the population size has been estimated at approximately 15.000 individuals (Coroiu *et al.*, 2008).

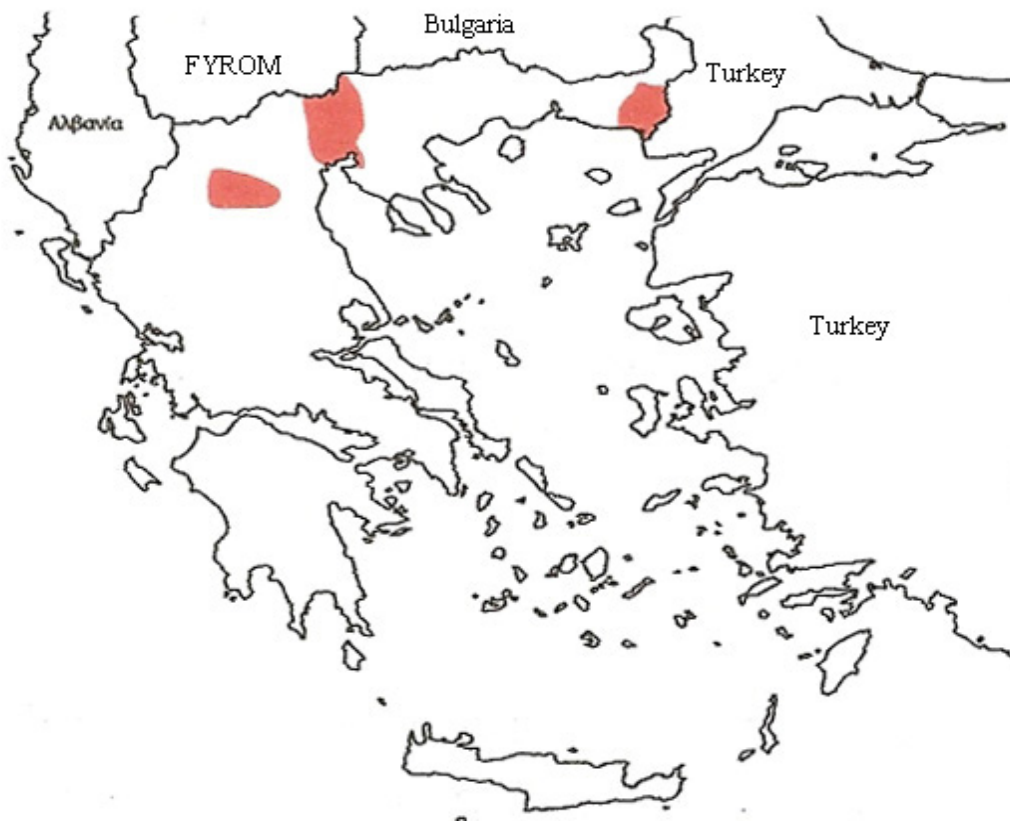
Data concerning its populations' status in the rest of its range, FYROM, Moldova, Romania, Serbia, and Ukraine, are not available.

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The Greek populations of the European ground squirrel are considered to be also in decline and severely fragmented (Youlatos, 2008), however systematic surveys concerning the occurrence and the ecology of the species are lacking. Data about the present and historical occurrence of the species are scarce, while data related to the biology and ecology of the species are available only from two populations in Thermi region, within the Thessaloniki Prefecture.

According to Youlatos (2008), the European ground squirrel occurs only in the northern part of Greece and includes 3 clearly defined and probably isolated sub-populations, located in western Macedonia, in central Macedonia and in Thrace. In western Macedonia, the species inhabits regions of Kozani and Giannitsa and in central Macedonia regions of the Axios valley, Gallikos, Hortiati, Thermi, Pilaia and region of Serres. In Thrace, there are populations in region of Alexandroupoli, in Evros delta and in isolated areas of north/north-eastern Evros Prefecture (Figure 1-2) (reviewed in Youlatos, 2008).

**Figure 1-2 European Ground Squirrel distribution in Greece**



Source: Youlatos (2008)

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These populations are considered as genetically and morphologically differentiated: in western and central Macedonia populations comprise the subspecies *Spermophilus citellus gradojevici*, whereas those in Thrace are formed by the subspecies *Spermophilus citellus martinoi* (reviewed in Youlatos, 2008; Helgen *et al.*, 2009).

More data about the distribution of *S. citellus* are provided in the fact sheets of the NATURA 2000 sites recording, according to which the species occurrence is broader and includes also regions of the Prefecture of Florina, Kastoria, Imathia and Pieria (*Table 1-1*). However, these data, including most of Youlatos' references also, come mainly from literature sources, which date several years back and lack recent verification in the field, with the exception of the Natura site of Axios, Loudias and Aliakmonas where the presence of the species was verified recently (Youlatos, pers.comm.) On the other hand, field studies have shown that the extinction risk of a colony is very high within only a few decades (Mateju *et al.*, 2008), thus it is very possible the species have become extinct in some of the reported locations. For example, although the presence of the *S. cittelus* in Dadia forest is reported in the Natura fact sheets, the species became extinct in 1992 during the dam construction in Lyra region and no colony has ever been observed since then (Catsadorakis and Bousbouras, 2010; Bousbouras, pers. comm.). *Table 1-1* contains a list of the sites where the presence of the species has been referred to, and where there is no current evidence of extinction.

**Table 1-1 Occurrence of *S.citellus* in Greece According to Literature**

<b>Sites</b>	<b>Prefecture</b>	<b>Reference</b>
Alexandroupoli	Evros (Thrace)	Ondrias 1965
Didimoticho	Evros (Thrace)	Niethammer 1974
Delta of Evros	Evros (Thrace)	Fraguedaki-Tsoli & Ondrias 1985 / Sfikas, 2004 (Natura fact sheets)
Koufovouno	Evros (Thrace)	Vohralik & Sofianidou 1992
Thourio	Evros (Thrace)	Vohralik & Sofianidou 1992
Fillakio	Evros (Thrace)	Vohralik & Sofianidou 1992
Haidou, Koula	Xanthi (Thrace)	Sfikas, 2004 (Natura fact sheets)
Kirnos	Xanthi (Thrace)	Vohralik & Sofianidou 1992
Olvio	Xanthi (Thrace)	Vohralik & Sofianidou 1992
Kerkini lake, Mt Krousia and Beles	Serres (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Valley of Timiou Prodromou	Serres (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Metalliko	Kilkis (Macedonia)	Vohralik & Sofianidou 1987

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<b>Sites</b>	<b>Prefecture</b>	<b>Reference</b>
Kalochori	Thessaloniki (Macedonia)	Vohralik & Sofianidou 1987
Sindos	Thessaloniki (Macedonia)	Vohralik & Sofianidou 1987
Malgara	Thessaloniki (Macedonia)	Chuworth-Masters 1932; Hadjinikolaou 1935
Lagathas	Thessaloniki (Macedonia)	Peus 1954
Kolchico	Thessaloniki (Macedonia)	Peus 1958
Kimina	Thessaloniki (Macedonia)	Ondrias 1966
Koronia	Thessaloniki (Macedonia)	Niethammer 1974
Lagathikia	Thessaloniki (Macedonia)	Ruzic 1978
Axios, Loudia and Aliakmonas deltas	Thessaloniki (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Volvi and Koronia lakes	Thessaloniki (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Plati	Imathia (Macedonia)	Peus 1958
Nisseli	Imathia (Macedonia)	Fraguedaki-Tsoli 1977
Stena Aliakmona	Imathia (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Seli	Imathia (Macedonia)	Kryštufek 2009
Mt Vermio	Imathia (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Tria Pigathia	Kozani (Macedonia)	Hatzisarantos et al. 1962
Kozani	Kozani (Macedonia)	Ondrias 1966
Pontokomi	Kozani (Macedonia)	Fraguedaki-Tsoli 1977
Mt Vourinos and valley of Mesiano Nero	Kozani (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Giannitsa	Pella (Macedonia)	Hatzisarantos et al. 1962
Amindaio	Florina (Macedonia)	Krystufek 2009
Himaditida and Zazari lakes	Florina (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Vegoritida and Petron lakes	Florina (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Mt Vitsi	Florina (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Kastoria lake	Kastoria (Macedonia)	Sfikas, 2004 (Natura fact sheets)
Kolindros	Pieria (Macedonia)	Ondrias 1965
Mt Pieria	Pieria (Macedonia)	Sfikas, 2004 (Natura fact sheets)

*Compiled by Migli (2013)*

## 1.2 Legislation Issues

Due to the decline of the species' range, especially in the southern, northern and north-western areas of its distribution, and the fact that its overall population decrease is suspected to have been more than 30% over the last years, the species is assessed as Vulnerable by the IUCN.

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That means that is considered to be facing a high risk of extinction in the wild. Moreover, the species is listed on Appendix II of the Bern Convention, which includes strictly protected fauna species. Furthermore, *S. citellus* is listed in Annexes II and IV of the EU Habitats and Species Directive, which include species requiring designation of Special Areas of Conservation, and species in need of strict protection, respectively. In accordance with the European legislation, the species is protected in Greece by the Presidential Declaration of 1981. Lastly, due to the decline of its population and the fragmentation of its habitat, the species is described as “Vulnerable” in the Red Data Book of Greece (Youlatos, 2008).

### 1.3 Field Survey Scope of Work

Field survey was focused on recording the presence of *Spermophilus citellus* colonies within 500 m buffer zone around the proposed pipeline route (250 m each side of the route).

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## 2 METHODOLOGY

### 2.1 Sampling Methodology

The fact that there is very limited recent information<sup>1</sup> on the current distribution and habitat preference of *Spermophilus* colonies in northern Greece made it a necessity that the 500 m Project area was searched as thoroughly as possible. To achieve this, the following procedure was employed:

The northern section of the 500 m zone was divided into 182 reference points (marked as R1, R2....R182 from east to west)<sup>2</sup> all lying in 1 km distance from the ones standing immediately east and west to them. In a similar way, the southern section of the 500 m zone was divided into 182 points (marked as L1, L2...L182 from east to west). All points will lie at a perpendicular distance of 175 m north or south respectively to the route. As a result, the core of the Project area was divided into 182 sampling blocks in the form of “R<sub>x</sub>R<sub>x+1</sub> - L<sub>x</sub>L<sub>x+1</sub>, x=1, 2 ....182”.

Searching for *Spermophilus* colonies was planned to take place at least once within each sampling blocks all along the route from Nea Mesimvria to the Greek-Albanian border. The area between two consecutive R – (or L-) points and the route is 17.5 ha which is a bit larger than the usual size reported in bibliography for a single *Spermophilus* colony in Bulgaria (1.5 – 10 ha<sup>3</sup>). As a result, clear-cut evidence of presence of *Spermophilus* colonies anywhere within two consecutive R or L points or in between R/L points is enough evidence that the particular location hosts at least one colony in the same site.

The following habitat types have been considered as unlikely to host *Spermophilus* colonies and therefore, blocks located within these habitats have been excluded from the sampling protocol:

- Forested areas such as *Quercus*, *Pinus* and *Fagus* forest;
- Sites with riparian vegetation;
- Heavily irrigated fields such as corn and cotton.

<sup>1</sup> All reports from Macedonia region derive from fieldwork on or before 1983 (see table 1.1) whereas the year of observation/collection of specimens recently discussed in Kryštufek & al 2009 is unknown.

<sup>2</sup> Points R182 and L182 lie within Albania

<sup>3</sup> Stefanov and Markova (2009)

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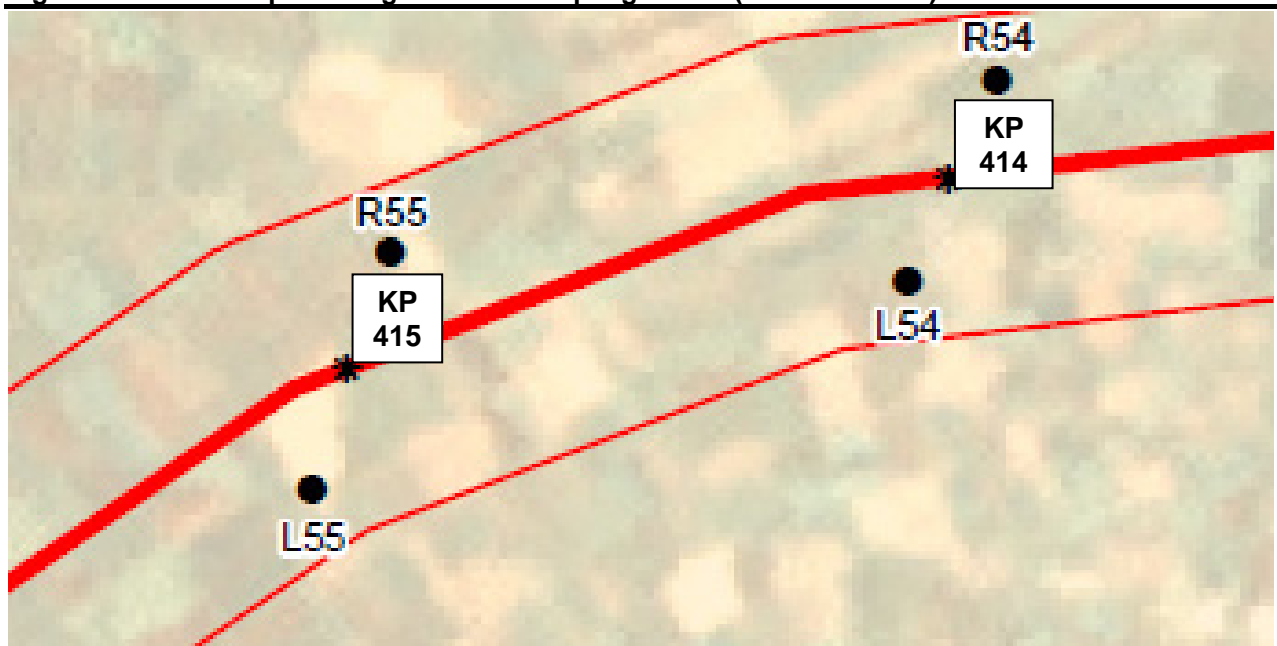
Heavily irrigated fields have been a concern because they could not be known beforehand as the type of cultivation in northern Greece may change annually. As a result, it was only during fieldwork that particular locations will have to be defined as “unlikely” or “likely” to host *Spermophilus* colonies.

When in the field, the following parameters have been considered as adequate evidence to indicate presence of a *Spermophilus* colony:

- Several holes on the ground with diameter > 6 cm, freshly dug which will lead into a tunnel underground AND at least two large holes (diameter > 10 cm) in the same location, freshly dug and leading to a wide tunnel underground
- Observation of the animal alive

A group of holes with diameters smaller than 6 cm and no observation of a large hole will be considered as evidence of *Microtus* (or *Rattus* in some cases) presence in the site. Symmetrical piles of fine-grained soil on the ground were considered as evidence of *Talpa* or *Microtus* presence. *Nannospalax* piles (similar but larger of those of *Talpa*) have not been observed within the Project area.

**Figure 2-1 Example of Alignment of Sampling Points (KP 414.1-415.1)**



Source: ERM (2011)

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Between the 4<sup>th</sup> and the 8<sup>th</sup> of July 2011, two pairs of scientists worked simultaneously in different route sections to cover the whole distance of the TAP Project area from central Macedonia (Nea Mesimvria) to the Greek/Albanian border. In May 2012 a second field survey took place, in order to incorporate data from unsearched blocks along the route and reassess the population occurrence. The sampling effort is described in the following table:

**Table 2-1 Sampling effort for *Spermophilus citellus* (July 2011 and May 2012)**

	Number	%
Total number of sampling blocks within the Project area	182	100
Number of sampling blocks searched at both the east and west section along the PPS	67	36.8
Number of sampling blocks searched at either (or both) the east or the west section along the PPS	95	52.2
Number of sampling blocks pre-determined as definitely unsuitable habitat	26	14.3
Number of sampling blocks not searched during fieldwork	59	32.4

Source: ERM (2011, 2012)

To sum up the information, 14.3% of the Project area has been considered as extremely unsuitable habitat for *Spermophilus citellus* colonies and was therefore not searched. Indeed, the percentage of the “extremely unsuitable” habitat is higher because part of the 32,4% of sampling blocks noted as “not searched” encompasses locations such as irrigated fields that have been defined during fieldwork as unlikely to host *Spermophilus* colonies and were therefore ignored. Twenty-three (23) blocks (31.5% of the “not searched” blocks or else 12.6% of the total number of blocks) lie west of the Kleisoura area to the Greek/Albanian border, a biogeographical unit for which there is limited bibliographic evidence of *Spermophilus citellus* colonies whatsoever.

## 2.2 Study Sites

The majority of the 183 km of TAP Greece - West along the 500 m zone comprises cultivated land. Cereal fields, clover / alfalfa fields and orchards were quite widespread, followed by meadows and fallow fields. Rice, cotton and corn fields were also very common but were all excluded from sampling, as they were heavily irrigated or the vegetation was rather dense and high. Habitats predetermined as extremely unsuitable were recorded between KP 369.2 and KP 372.5 of the route, where the riparian valley of Axios river is located, between KP 425.4 and KP 436.5 and KP 438.8 to KP 448.8 as well, where the forested areas of Mt Vermio are included and in-between KP 493.4 and KP 494.4, including the dense forest north of Kleisoura (Table 2-2).

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**Table 2-2 Sampling locations/ observations for *permophilus citellus* and/or *Spermophilus* habitat along the route**

<b>Sample No.</b>	<b>GPS point*</b>	<b>KP</b>	<b>Area</b>	<b>Habitat type</b>	<b>Distance to pipeline centreline</b>	<b>Other remarks</b>
1	KP002	359.8	Nea Mesimvria	Vineyard	159 m	No animal species of interest was detected
2	KP003	359.9	Nea Mesimvria	Cropped wheat field	12 m	No animal species of interest was detected
3	KP004	361.2	Between Nea Mesimvria and Agios Athanasios	Cropped wheat field	89 m	Spot indicated by a local land owner
4	KP005	361.3	Between Nea Mesimvria and Agios Athanasios	Cropped wheat field	175 m	Spot indicated by a local land owner
5	KP006	361.2	Between Nea Mesimvria and Agios Athanasios	Cropped cereals (possibly wheat)	115 m	No animal species of interest was detected
6	KP007	361.5	Between Nea Mesimvria and Agios Athanasios	Cropped cereals (possibly wheat)	122 m	-
7	KP008	361.2	Between Nea Mesimvria and Agios Athanasios	Cropped cereals (possibly wheat)	289 m	-
8	KP009	364	Agios Athanasios	Cropped cereals (possibly wheat)	384 m	Outside of 500m pipeline zone. <i>Merops apiaster</i> nests. Unidentified group of holes
9	KP011	365.3	East of Gefyra	Cropped cereals (possibly wheat)	195 m	No animal species of interest was detected
10	KP012	366.5	Gefyra	Cropped cereals (possibly wheat)	69 m	No animal species of interest was detected
11	KP013	366.5	Gefyra	Cropped cereals (possibly wheat)	80 m	No animal species of interest was detected
12	MM11	367	Gefyra	Cropped wheat field	432 m	Surroundings of cropped wheat fields and vineyards. Spot indicated by a local land owner.
13	MM10	367.3	Gefyra	Sunflower cultivation	69 m	Surroundings of potatoes, ploughed fields and wheat cultivations. No animal species of interest was detected.
14	MM9	367.5	Gefyra	Cropped wheat field	343 m	Surroundings of vineyards and other wheat crops. No animal species of interest was detected.
15	MM13	368.2	West of Gefyra	Cropped wheat field	168 m	Surroundings of cotton cultivations, vineyards and ploughed fields
16	MM12	368.3	West of Gefyra	Cropped wheat field	528 m	Surroundings of cotton and cropped wheat cultivations
17	MM14	369.2	Axios river	Dirt road	986 m	Road crossing mainly maize fields

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18	MM2	376	Parthenio	Cropped wheat field	10m	Surroundings of cotton cultivations. No animal species of interest was detected.
19	MM4	376	Parthenio	Fallow field (under cotton cultivation in the past)	214 m	Surroundings of cotton cultivations, ground heavily ploughed. <i>Microtus</i> spp was detected.
20	MM3	376.3	Parthenio	Fallow field	129 m	Surroundings of rice cultivations. <i>Microtus</i> spp was detected.
21	MM1	376.9	Parthenio	Fallow field (under cotton cultivation in the past)	294 m	Outside of 500 m pipeline zone. Surroundings of cotton cultivations. No animal species of interest was detected.
22	MM5	376.9	Parthenio	Alfalfa field	132 m	Surroundings of cotton and rice cultivations. <i>Microtus</i> spp was detected.
23	MM6	377.9	Between Parthenio and Mikro Monastirio	Cotton field	150m	Surroundings of cotton and maize cultivations. No animal species of interest was detected
24	MM7	378.6	Between Parthenio and Mikro Monastirio	Fallow field with sparsely dense reed vegetation.	220 m	Surroundings of cotton and maize fields. <i>Microtus</i> spp was detected
25	MM8	379.2	Between Parthenio and Mikro Monastirio	Fallow field	316 m	Outside of 500 m pipeline zone. Field used as pasture for livestock. Surroundings of maize and cotton fields. <i>Microtus</i> spp and/or <i>Talpa</i> spp were detected.
26	MM15	384.9	West of Mikro Monastirio	Cropped wheat field and ploughed field	458 m	Surroundings by maize, rice and cotton cultivations. <i>Microtus</i> spp was detected
27	MM16,2	384.9	West of Mikro Monastirio	Cropped wheat field	378 m	Surroundings of maize and cotton fields. No animal species of interest was detected
28	MM17	384.9	West of Mikro Monastirio	Ploughed cotton field (seemed to be abandoned)	320 m	Surroundings of maize and cotton fields. <i>Microtus</i> spp. was detected
29	MM18	387.9	East of Paralimni	Cropped wheat field	115 m	Surroundings of ploughed cotton fields. No animal species of interest was detected.
30	MM19,2	387.9	East of Paralimni	Alfalfa field of sparse vegetation	26 m	Surroundings of ploughed cotton fields. No animal species of interest was detected.

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31	MM70	391.4	North of Loudias river	Cropped clover field	5 m	Surroundings of clover, wheat and maize fields, inside NAGREF farm. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected. Information provided by local people gives evidence of the presence of a <i>Spermophilus</i> -like animal, especially along the dirt roads of the farm.
32	KP017	393.7	SW of Paralimni (Giannitsa)	Cotton field	611 m	No animal species of interest was detected.
33	KP016	393.8	SW of Paralimni (Giannitsa)	Cropped cereals	518 m	Outside the 500m pipeline zone. Surroundings of corn and cotton fields. <i>Microtus</i> spp or <i>Rattus</i> sp. was detected
34	KP015	394.1	SW of Paralimni (Giannitsa)	Plantation of <i>Populus</i> sp.	372 m	Outside the 500 m pipeline zone, close to "Vagelis" café
35	KP018	394.1	SW of Paralimni (Giannitsa)	Corn and cotton fields	903 m	No animal species of interest was detected
36	KP019	395	SW of Giannitsa	Corn and cotton fields	1209 m	No animal species of interest was detected
37	KP021	396	SW of Giannitsa	Rose fields	1335 m	No animal species of interest was detected.
38	KP020	396.2	SW of Giannitsa	Apple trees field	916 m	No animal species of interest was detected
39	KP022	396.9	SW of Giannitsa	Fallow field	556 m	<i>Microtus</i> spp or <i>Rattus</i> sp. was detected
40	KP023	397	SW of Giannitsa	Fallow field	412 m	<i>Microtus</i> spp or <i>Rattus</i> sp. was detected
41	KP024	399.5	South of Kariotissa	Fallow field	29 m	<i>Talpa</i> sp. was detected
42	KP025	399.6	South of Kariotissa	Fallow field	133 m	No animal species of interest was detected
44	KP028	400	South of Kariotissa	Meadow	91 m	<i>Talpa</i> sp. was detected
48	KP032	402.8	Agios Loukas	Alfalfa field	48 m	No animal species of interest was detected
49	KP033	403.1	Agios Loukas	Harvested field	23 m	No animal species of interest was detected
51	KP035	405.5	Between Agios Loukas and Esovalta	Alfalfa field	225 m	No animal species of interest was detected
52	KP036	405.4	Between Agios Loukas and Esovalta	Harvested field covered with straws	80 m	No animal species of interest was detected
53	KP037	406.7	Esovalta	Alfalfa field	246 m	Garbage area. No animal species of interest was detected
54	KP038	411.5	Aspron	Alfalfa field	133 m	Garbage area. No animal species of interest was detected
55	KP039	419.3	Plevroma	Cropped wheat field	148 m	No animal species of interest was detected
56	KP040	419.3	Plevroma	Cropped wheat field	218 m	No animal species of interest was detected
57	KP041	419.3	Plevroma	Cropped wheat field	179 m	No animal species of interest was detected
58	KP042	419.3	Plevroma	Cropped wheat field	122 m	No animal species of interest was detected

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59	KP043	420.2	Plevroma	Cropped wheat field	36 m	No animal species of interest was detected
60	KP044	419.9	Plevroma	Cropped wheat field	35 m	No animal species of interest was detected
61	KP045	419.9	Plevroma	Cropped wheat field	61 m	No animal species of interest was detected
62	KP046	420.2	Plevroma	Cropped wheat field	58 m	No animal species of interest was detected
63	KP047	420.4	Loutrochorion	Cropped wheat field	24 m	No animal species of interest was detected
64	KP048	420.5	Loutrochorion	Cropped wheat field	45 m	No animal species of interest was detected
65	KP049	420.5	Loutrochorion	Cropped wheat field	72 m	No animal species of interest was detected
66	KP050	420.6	Loutrochorion	Cropped wheat field	66 m	No animal species of interest was detected
67	KP051	421	Loutrochorion	Cropped wheat field	140 m	No animal species of interest was detected
68	KP052	421.8	Loutrochorion	Cropped cereals and peach trees 'field	154 m	No animal species of interest was detected
69	KP053	422.1	Loutrochorion	Cropped cereals and peach trees 'field	155 m	No animal species of interest was detected
70	KP054	422.1	Loutrochorion	Cropped cereals and peach trees 'field	93 m	No animal species of interest was detected
71	KP055	422.1	Loutrochorion	Cropped cereals and peach trees 'field	239 m	No animal species of interest was detected
72	KP056	422	Loutrochorion	Cropped cereals and peach trees 'field	233 m	No animal species of interest was detected
73	KP057	422	Loutrochorion	Cropped cereals and peach trees 'field	166 m	No animal species of interest was detected
74	KP058	422.1	Loutrochorion	Dirt road	94 m	Orchards around. No animal species of interest was detected
75	KP059	422.3	Loutrochorion	Dirt road	32 m	Orchards around. No animal species of interest was detected
79	KP063	437	NE of Ano Grammatiko (Vermio Mt)	Meadow	212 m	<i>Microtus</i> spp and/or <i>Talpa</i> spp. were detected. Field within <i>Fagus</i> forest (Vermio Mt)
80	KP064	438.1	NE of Ano Grammatiko (Vermio Mt)	Meadow	136 m	<i>Microtus</i> spp and/or <i>Talpa</i> spp. were detected. Field within <i>Fagus</i> forest (Vermio Mt)
81	KP065	449.4	Pyrgoi	Cropped cereals	150 m	No animal species of interest was detected

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82	KP066	449.1	Pyrgoi	Cropped cereals	25 m	No animal species of interest was detected
83	KP067	449.1	Pyrgoi	Cropped cereals	149 m	No animal species of interest was detected
84	KP068	449.3	Pyrgoi	Cropped cereals	23 m	No animal species of interest was detected
85	KP069	449.3	Pyrgoi	Cropped cereals	38 m	No animal species of interest was detected
86	KP070	449.3	Pyrgoi	Cropped cereals	73 m	No animal species of interest was detected
87	KP071	449.3	Pyrgoi	Cropped cereals	213 m	No animal species of interest was detected
88	KP072	449.3	Pyrgoi	Cropped cereals	410 m	No animal species of interest was detected
89	KP073	451.2	Between Pyrgoi and Maniakio	Cropped cereals	7 m	No animal species of interest was detected
90	KP074	451	Between Pyrgoi and Maniakio	Cropped cereals	147 m	No animal species of interest was detected
91	KP075	451	Between Pyrgoi and Maniakio	Cropped cereals	151 m	No animal species of interest was detected
92	KP076	451	Between Pyrgoi and Maniakio	Cropped cereals	109 m	No animal species of interest was detected
93	KP077	451	Between Pyrgoi and Maniakio	Cropped cereals	160 m	No animal species of interest was detected
94	KP078	450.9	Between Pyrgoi and Maniakio	Cropped cereals	219 m	No animal species of interest was detected
95	KP079	450.9	Between Pyrgoi and Maniakio	Meadow with sparse maquis	214 m	<i>Microtus</i> spp or <i>Rattus</i> sp. was detected
96	KP080	450.8	Between Pyrgoi and Maniakio	Meadow with sparse maquis	194 m	<i>Microtus</i> spp or <i>Rattus</i> sp. was detected
97	MM20	453.8	South of Maniakio	Fallow field of short vegetation (under cereal crop in the past)	48 m	Field used as pasture, with stands of <i>Quercus</i> sp. <i>Microtus</i> spp. and <i>Lepus europaeus</i> were detected.
98	MM21	453.8	South of Maniakio	Meadow of medium inclination with low vegetation	39 m	Sparse stands of <i>Quercus</i> sp., <i>Juniperus oxycedrus</i> and sage-leaved pear.
99	MM22.2	454.5	South of Maniakio	Meadow of medium inclination, with very low vegetation	108 m	Gaps and sparse stands of <i>Quercus</i> sp., <i>Juniperus oxycedrus</i> etc. Vegetation gets denser to the foothill, where maize fields are located. <i>Microtus</i> spp. was detected (many holes)
100	MM23	454.6	South of Maniakio	Fallow field of very low, sparse vegetation	3 m	Next to the main road.
101	MM24	454.6	South of Maniakio	Meadow of low inclination	37 m	Loose stands of <i>Quercus</i> sp., sage-leaved pear and <i>Juniperus oxycedrus</i> . No animal species of interest was detected.
102	MM25.2	455.4	North of Antigonos	Cropped cereal field	37 m	Surroundings of maize fields. <i>Microtus</i> spp. was detected

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103	MM26.1	455.9	North of Antigonos	Fallow field of short vegetation	252 m	Surroundings of maize fields. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected.
104	MM27.1	456.7	Antigonos	Cropped wheat field	21 m	Surroundings of maize fields. No animal species of interest was detected.
105	MM28	456.7	Antigonos	Apple orchard	117 m	Surroundings of other orchards and maize fields. <i>Microtus</i> spp. was detected
106	MM29	457.7	Antigonos	Dense meadow of wild graminiae	35 m	Surroundings of orchards and maize fields. <i>Microtus</i> spp. was detected.
107	MM30	458.5	Antigonos	Apricot trees' field with dense ground cover	163 m	Surroundings of maize fields and orchards. <i>Microtus</i> spp. and/or <i>Talpa</i> spp. were detected.
108	MM31.1	459.3	West of Pelargos	Almond trees' field	10 m	Surroundings of maize and alfalfa fields. <i>Microtus</i> spp. and/or <i>Talpa</i> spp. were detected.
109	MM32	460.6	East of Filotas	Cropped wheat field	191 m	Surroundings of maize fields. <i>Microtus</i> spp. was detected.
110	MM33	462.6	SE of Filotas	Cropped cereals' field	49 m	Surroundings of apricot trees and other orchards. <i>Microtus</i> spp. was detected.
111	MM34.1	463.2	West of Komnina	Cropped alfalfa field	86 m	Surroundings of clover and maize fields. <i>Microtus</i> spp. was detected.
112	MM35.2	464	West of Komnina	Cropped alfalfa field	64 m	Surroundings of clover and maize fields and few cropped cereals. <i>Microtus</i> spp. was detected.
113	MM36	464.9	West of Komnina	Cropped alfalfa field	14 m	Surroundings of cereals, clover and maize fields. <i>Microtus</i> spp. was detected.
114	KP081	470.9	Perdikkas	Meadow	130 m	Field on the main road, next to a gas station, a house and a cropped cereals' field
115	KP082	470.8	Perdikkas	Meadow	93 m	No animal species of interest was detected
116	KP083	471	Perdikkas	Meadow	238 m	Dense, dry vegetation.
117	KP084	471.6	Perdikkas	Meadow	35 m	Dense, dry vegetation.
118	KP085	471.6	Perdikkas	Meadow	66 m	Dense, dry vegetation.
119	KP086	471.6	Perdikkas	Meadow	53 m	Dense, dry vegetation.
120	KP087	471.6	Perdikkas	Meadow	126 m	Dense, dry vegetation.
121	KP088	473.4	North of Ptolemaida	Meadow	96 m	Dense, dry vegetation. No animal species of interest was detected.
122	KP090	474.9	NW of Ptolemaida	Meadow	79 m	Dense, dry vegetation.
126	KP094	479	Drosero	Alfalfa field	207 m	South of lake Chimaditis
127	KP095	479	Drosero	Alfalfa field	143 m	South of lake Chimaditis
128	KP096	481.5	Galateia	Alfalfa field	122 m	South of lake Chimaditis

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129	MM37	488.9	Varikon	Fallow field (under cereal crop in the past)	433 m	Field used as pasture for sheeps grazing, surrounded by other cereal crops and vegetables. No animal species of interest was detected
130	MM38	488.5	Varikon	Clover field of short vegetation.	127 m	Surroundings of cereals and vegetables. <i>Talpa</i> spp and/or <i>Microtus</i> spp were detected
131	MM39	489.4	Varikon	Short clover field	9 m	Surroundings of cereal fields. <i>Talpa</i> spp and/or <i>Microtus</i> spp were detected.
132	MM40	488.9	Varikon	Cropped wheat and alfalfa field	38 m	Surroundings of wheat and maize fields. No animal species of interest was detected
133	MM41	489.9	Varikon	Fallow field of wild graminiae and clover plants	29 m	Surroundings of <i>Quercus</i> stands. No animal species of interest was detected
134	MM42	490.3	Varikon	Fallow field	266 m	Field used for grazing, Surroundings of other fallow fields, cereal crops and forest vegetation. No animal species of interest was detected
135	MM43	491.4	Kleisoura	Cropped cereal field	251 m	Signs of livestock grazing. Surroundings of <i>Quercus</i> stands and cereal crops. <i>Microtus</i> spp was detected.
136	MM44	492.1	Kleisoura	Cropped wheat field	51 m	Surroundings of <i>Quercus</i> stands and other cereal crops. <i>Microtus</i> spp was detected.
137	MM45	492.9	Kleisoura	Pasture of low vegetation	30m	Surroundings of <i>Quercus</i> and <i>Pinus</i> trees. <i>Microtus</i> spp and <i>Talpa</i> spp were detected.
138	MM46	495.7	Verga	Fallow field of medium height vegetation and gaps.	15 m	Surroundings of <i>Quercus</i> stands and fields - pastures. <i>Microtus</i> spp was detected
139	MM47	496.4	SW of Verga	Clover field with gaps	171m	Surrounded by forestland. <i>Microtus</i> spp was detected.
140	MM48	498.1	East of Stavropotamos	Fallow field	106 m	Signs of grazing. Surroundings of cereal crops, vegetables and orchards. <i>Talpa</i> spp and/or <i>Microtus</i> spp were detected.
141	MM49	498.4	East of Stavropotamos	Vineyard ,not ploughed	196 m	Surroundings of cereal and clover fields. No animal species of interest was detected
142	MM50	498.7	East of Stavropotamos	Fallow field of very short vegetation	25 m	Field used as pasture for livestock. Surroundings of clover, maize and cereals fields. <i>Microtus</i> spp was detected.

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143	MM51	499.2	East of Stavropotamos	Clover field	78m	Surroundings of maize and corn fields. <i>Microtus</i> spp was detected.
144	MM52	500.8	West of Lithia	Fallow field of sparse vegetation	126 m	Surroundings of cereals, vegetables and apple trees. Additional sampling within apple trees field was conducted. <i>Microtus</i> spp was detected.
145	MM53	501.9	West of Lithia	Mixed crop of clover and cereals (cropped)	134 m	Surroundings of orchards, cereals and maize cultivations. <i>Microtus</i> spp was detected.
146	MM54	502.3	West of Lithia	Cropped wheat field	195 m	Surroundings of vegetables, maize and orchards. No animal species of interest was detected.
147	MM55	503.3	Korissos	Cropped wheat field	78 m	Surroundings of wheat fields. <i>Microtus</i> spp was detected
148	MM56	503.8	Korissos	Cropped alfalfa field	51m	Surroundings of cereals. <i>Microtus</i> spp was detected.
149	MM57	504.2	Korissos	Cropped wheat field with gaps	79 m	Surroundings of cereals. <i>Microtus</i> spp was detected.
150	MM58	505.1	West of Korissos	Cropped cereals	70 m	Surroundings of maize and cereal cultivations. <i>Microtus</i> spp was detected.
151	MM59	506.2	West of Korissos	Cropped cereals	32 m	Surroundings of orchards, maize and cereal cultivations. <i>Microtus</i> spp was detected
152	MM60	507.7	East of Krepeni	Clover field of very short vegetation,	408 m	Ground very poor. Surroundings of fallow fields, clover fields, orchards and maize cultivations. <i>Microtus</i> spp was detected.
153	MM61	509.3	SE of Krepeni	Cropped clover	128 m	Surroundings of wheat and clover cultivations. <i>Microtus</i> spp was detected. 3-5 holes of 6-7 cm diameter were recorded. Information provided by local people gives evidence of the presence of a <i>Spermophilus</i> -like animal.
154	MM62.1	509.1	SE of Krepeni	Clover field of short vegetation	189 m	Surroundings of cereals, clover and maize fields, orchards and dense meadows. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected.
155	MM63.1	509.9	SE of Krepeni	Cropped alfalfa field of low vegetation	79 m	Surroundings of dense clover fields. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected

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156	MM64.1	510.8	North of Militsa	Apple trees' field with dense ground cover	105 m	Surroundings of maize and fallow fields, dense meadows, cereals, vegetables and ploughed orchards. <i>Microtus</i> spp. and/or <i>Talpa</i> spp. were detected
157	MM65.2	511.1	North of Militsa	Apple trees' field	47 m	Surroundings of dense meadows and vegetables fields. <i>Microtus</i> spp. and/or <i>Talpa</i> spp. were detected.
158	KP097	512.2	Militsa	Arable land and meadows	101 m	South of Kastoria lake. No animal species of interest was detected.
159	KP098	512.2	Militsa	Arable land and meadows	38 m	South of Kastoria lake. No animal species of interest was detected.
160	KP099	512.2	Militsa	Arable land and meadows	149 m	South of Kastoria lake. No animal species of interest was detected.
161	KP100	512.3	Militsa	Arable land and meadows	134 m	South of Kastoria lake. No animal species of interest was detected.
162	KP101	512.4	Militsa	Arable land and meadows	152 m	South of Kastoria lake. No animal species of interest was detected.
163	KP102	512.6	Militsa	Arable land and meadows	196 m	South of Kastoria lake. No animal species of interest was detected.
164	KP103	512.6	Militsa	Arable land and meadows	57 m	South of Kastoria lake. No animal species of interest was detected.
165	KP104	512.6	Militsa	Arable land and meadows	171 m	South of Kastoria lake. No animal species of interest was detected.
166	KP106	513	Militsa	Arable land and meadows	131 m	South of Kastoria lake. No animal species of interest was detected.
167	KP107	513	Militsa	Arable land and meadows	189 m	South of Kastoria lake. No animal species of interest was detected.
168	KP108	513.7	Ampelokipoi	Arable land and meadows	21 m	South of Kastoria lake. No animal species of interest was detected.
169	KP109	514	Ampelokipoi	Arable land and meadows	162 m	South of Kastoria lake. No animal species of interest was detected.
170	KP110	514	Ampelokipoi	Arable land and meadows	70 m	South of Kastoria lake. No animal species of interest was detected.
171	MM66.2	516.6	Dispilio	Cropped clover field	56 m	Surroundings of dense meadows and fallow fields. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected.
172	MM67	517	Dispilio	Cropped wheat field	164 m	Surroundings of dense meadows. No animal species of interest was detected.

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173	MM68.2	518	Dispilio	Cropped wheat field	6 m	Surroundings of cereals and other cropped wheat fields. <i>Microtus</i> spp. or <i>Rattus</i> sp. was detected. (probably inactive holes)
174	MM68.1	519.2	North of Argos Orestiko	Cropped clover field	18 m	Surroundings of dense meadows and cropped cereals. No animal species of interest was detected.
175	KP126	532.6	Agia Kyriaki Velventou	Arable land (mostly cereals) with meadows in patches	178 m	No animal species of interest was detected.
176	KP127	532.6	Agia Kyriaki Velventou	Arable land (mostly cereals) with meadows in patches	261 m	No animal species of interest was detected.
177	KP128	532.6	Agia Kyriaki Velventou	Arable land (mostly cereals) with meadows in patches	206 m	<i>Microtus</i> spp. or <i>Rattus</i> sp. was detected.
178	KP111	542.8	SW of Ieropigi	Arable land (mostly cereals) with meadows in patches	118 m	No animal species of interest was detected.
179	MP87	479.2	NE of Drosero	Corn field with quite dense and medium-height vegetation	162 m	South of small stream
180	MP88	479.3	NE of Drosero	A row of riparian vegetation	132 m	Close to a stream with high flow, next to cultivated fields
181	MP89	479.3	NE of Drosero	Corn field with quite dense and medium-height vegetation	17 m	South of small stream
182	MP90	479.1	NE of Drosero	Corn field with quite dense and medium-height vegetation	155 m	
183	MP91	479.3	NE of Drosero	Corn field with quite dense and medium-height vegetation	150 m	South of small stream
184	MP92	479.5	Drosero	An uncultivated row of meadow between cropped fields	97 m	North of the stream

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Sample No.	GPS point*	KP	Area	Habitat type	Distance to pipeline centreline	Other remarks
185	MP93	481.5	Galateia (south of lake Chimaditis)	Dense alfalfa field with gaps	330 m	
186	MP94	481.5	Galateia (south of lake Chimaditis)	Corn filed NW, Alfalfa field SE	60 m	
187	MP95	481.5	Galateia (south of lake Chimaditis)	At the edge of a dirt road	55 m	
188	MP96	481.6	Galateia (south of lake Chimaditis)	Border of corn field	61 m	Unconfirmed presence. A few questionable holes at the border of the field
189	MP97	481.9	SW of Galateia	Alfalfa field	39 m	
190	MP98	482.1	SW of Galateia	To the edge of a dirt road	33 m	
191	MP99	482.2	SW of Galateia	Wet (?) meadow	19 m	Presence of orchids
192	MP108	482.8	SW of Galateia	Fallow field of short, sparse vegetation	90m	Recently ploughed
193	MP121	483.2	SW of Galateia	Fallow field of short, sparse vegetation	281 m	<i>Microtus</i> spp. was detected
194	MP151	483.9	North of Foufas	Dense wheat field	20 m	
195	MP152	478.5	East of Drosero	Meadow with low, dense vegetation with gaps	186 m	
196	MP153	478.5	East of Drosero	Meadow with low, dense vegetation with gaps	13 m	
197	MP154	478.5	East of Drosero	Meadow with low, dense vegetation with gaps	27 m	
198	MP155	478.4	East of Drosero	Meadow with low, dense vegetation with gaps.	96 m	Three holes observed attributed to unspecified mammal
199	MP156	474.9	NW of Ptolemaida	Fallow field with short, sparse vegetation	57 m	Large quantity of soil removed
200	MP157	471.5	Southern of Perdikkas	Fallow field with short, sparse vegetation	70 m	
201	MP158	471.6	Southern of Perdikkas	Fallow field	98 m	
202	MP159	470	Southern of Perdikkas	Meadow of medium inclination with low vegetation	325 m	Unconfirmed presence of colony. Holes detected but not as extensive, big and abundant as the ones seen in the previous field trip. Carnivore faeces and a very large nest / roosting site observed
203	MP160	470.2	Southern of Perdikkas	Fresh wheat field	52 m	

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204	MP161	469.6	Southern of Perdikkas	Fresh wheat field	13 m	
205	MP162	468.5	North of Pentavrysos	Meadow of short vegetation	14 m	River crossing
206	MP163	469	East of Pentavrysos	Wheat field that seems abandoned	107 m	
207	MP164	466.9	East of Perdikkas	Fallow field (under crop in the past) of short, sparse vegetation	56 m	Next to the train route
208	MP165	466	NE of Perdikkas	Fallow field of short, sparse vegetation, recently ploughed	225 m	Under crop in the past. Possible presence of <i>Microtus spp.</i>
209	MP166	465.1	NE of Perdikkas	Meadows with low vegetation	43 m	<i>Microtus spp.</i> was detected
210	MP167	390.8	Paralimni	Meadow within Giannitsa plain	2,494 m	
211	MP168	391	Paralimni	Meadow within Giannitsa plain	2,507 m	
212	MP169	393.8	SW of Paralimni (Giannitsa valley)	Riparian forest next to Loudias river	217 m	Absence of suitable habitat for sampling
213	MP170	366.5	North of Gefyra	Fallow field of very short, sparse vegetation	59 m	Under cereal crop in the past
214	MP171	366.6	North of Gefyra	Dense meadow with gaps.	291 m	No animal species of interest was detected.
215	MP172	367.9	NW of Gefyra	Dense meadow of short vegetation.	122 m	No animal species of interest was detected.
216	MP173	368	NW of Gefyra	Meadow of short vegetation.	63 m	No animal species of interest was detected.
217	MP174	368.1	NW of Gefyra	Meadow.	18 m	Surroundings of dense fresh wheat fields. No animal species of interest was detected.
218	MP175	368.4	NW of Gefyra	Fallow field of short vegetation.	123 m	Under cereal crop in the past. No animal species of interest was detected.
219	MP176	368.5	NW of Gefyra	Abandoned wheat field.	0 m	
220	MP177	368.5	NW of Gefyra	Field of <i>Avena</i> sp.	110 m	Unconfirmed presence of colony. 6-7 holes, resembling those of <i>Spermophilus</i> observed but due to recent rainstorm, the openings have slid to the sides

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<b>Sample No.</b>	<b>GPS point*</b>	<b>KP</b>	<b>Area</b>	<b>Habitat type</b>	<b>Distance to pipeline centreline</b>	<b>Other remarks</b>
221	MP178	369.2	Axios river	Fallow field (under cereal crop in the past) of short vegetation (Oat, wheat etc.)	201 m	
222	MP179	369.7	Axios river	Dense meadow close to the river	23 m	No animal species of interest was detected
223	MP180	369.8	Axios river	Field of low, sparse vegetation, within the flood zone of Axios river.	58 m	No animal species of interest was detected.
224	MP182	369.8	Axios river	Field of low, sparse vegetation, within the flood zone of Axios river.	71 m	No animal species of interest was detected.
225	MP183	370.1	Axios river	Field of low, sparse vegetation, within the flood zone of Axios river.	115 m	No animal species of interest was detected.
226	MP184	370.2	Axios river	Axios river, forest of Salix alba and Populus alba	127 m	Absence of suitable habitat for sampling
227	MP185	369.8	Axios river	On the dirt road, close to Axios river.	58 m	
228	MP193	393.1	SW of Paralimni (Giannitsa valley)	Large maize cultivations.	11 m	Absence of suitable habitat for sampling. No sampling was conducted
229	MP194	393.2	SW of Paralimni (Giannitsa valley)	Meadow of dense vegetation (mainly Avena sp), close to Loudias river.	42 m	No animal species of interest was detected.
230	MP195	393.8	SW of Paralimni (Giannitsa valley)	Riparian forest of Loudias river.	246 m	Absence of suitable habitat for sampling.
231	MP197	397.3	SW of Giannitsa	Large maize cultivations	90 m	Absence of suitable habitat for sampling. No sampling was conducted
232	MP198	396.7	SW of Giannitsa	Large ploughed field, maize and wheat cultivations in the surroundings	20 m	Absence of suitable habitat for sampling. No sampling was conducted

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Sample No.	GPS point*	KP	Area	Habitat type	Distance to pipeline centreline	Other remarks
233	MP199	396.5	SW of Giannitsa	Large ploughed field, maize and wheat cultivations in the surroundings	99 m	Absence of suitable habitat for sampling. No sampling was conducted
234	MP200	395.8	SW of Giannitsa	Large ploughed field, maize and wheat cultivations	286 m	Absence of suitable habitat for sampling. No sampling was conducted
235	MP201	394.5	SW of Giannitsa	Recently ploughed field.	84 m	Absence of suitable habitat for sampling. No sampling was conducted

Notes: \* The 'GPS Point' prefixes relate to the surname of the surveyors:  
'KP' = Kallivoka-Papapavlou  
'MM' = Migli-Mertzanidou  
'MP' = Migli-Papapavlou

Source: ERM field surveys (2011 and 2012)

### 2.3 Limitations, Uncertainties and Bias

- The locations of *Spermophilus* colonies presented in this report (see Section 3) should be considered as the minimal range of the species within the Project area. It is possible that additional colonies (or an expansion of an already recorded colony) may be found either within some of the unsearched blocks or the borders of an already searched block for which no colony is otherwise stated.
- The persistence of colonies from one year to the next cannot be predicted: in the Czech Republic, some colonies seem to have vanished from one year to the next (Mateju *et al.*, 2008) and the reason in several cases is unknown. There is inadequate data to check if such turnover events also occur within Greece but if they do, it is possible that colonies abandon one site, vanish or re-establish themselves somewhere else even within a year.

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### 3 RESULTS

#### 3.1 *Spermophilus citellus* Colonies

There are twenty eight (28) observation points/sampling locations along the route confirming presence of *Spermophilus*. The main habitat types where the species was found comprised meadows (32.1%), cereals' field (25%), alfalfa field (21.4%), dirt roads (10.7%) and fallow fields (10.7%). The detected locations seem to form two large groups, clearly separated geographically from each other: The eastern population ranges from Nea Mesimvria, NW of Thessaloniki, to the valley of Axios river, north of Gefyra village. Nine (9) sampling locations checked within this area were found to host a *Spermophilus* population, six (6) of them lying in cereals' fields, one (1) in a meadow and another two within a dirt road, quite close to Axios river. It is unknown if these observations refer to one, two or even more colonies, all loosely structured and possibly lying even outside the TAP 500 m zone. Communication within these sites especially between KP 361.2 to KP 396.2 seems possible, as there is no clear separating factor and the distance among them is rather short.

The western population group extends in a much larger range, between the lakes Vegoritida and Chimaditis, corresponding to the area from KP 453.8 to KP 482.1. There are eighteen (18) observation points/sampling locations along the route confirming presence of *Spermophilus* colonies at this part of the route, with the majority of them (44.4%) lying in meadows, followed by alfalfa fields (33.3%), fallow fields (11.1%) and cereals fields (5.5%).

The *Spermophilus* burrows detected at KP 367.2 and partly at KP 369.2 are located outside the 500 m zone, but probably the colony they are part of, extends also within the 500 m zone. There was finally another colony detected in-between the two major population groups, above KP 391 of the route, quite close to Paralimni village, but it was located over 2 km away of the 500 m zone. Thus, it was included in the areas of presence, as there is a minor possibility of future migration of the animals, as long as there is no clear obstacle to prevent it.

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**Table 3-1 Confirmed *Spermophilus citellus* Presence in the Study Area**

No.	GPS POINT	Geographical area	Approx. KP chainage	Habitat	General comments
1	KPL004 (block R1/L1-R2/L2)	Between Nea Mesimvria and Agios Athanasios	361.2	Cropped wheat field	Group of holes close to the road, identified as <i>Spermophilus</i> colony. Large (>10 cm diameter) tunnel next to the road. Several holes (min 40) in the wheat field (already harvested) extending to the north. One very large hole (>>10 cm diam) observed at the northern border of the field. One sighting of the animal (head emerging from a hole). Faeces nowhere observed. Colony possibly extending further north outside the 500 m zone and further west. Sightings of KPL004, KPL007 and KPL008 might all comprise holes of a single <i>Spermophilus</i> colony.
2	KPL007 (block R2/L2-R3/L3)	Between Nea Mesimvria and Agios Athanasios	361.5	Cropped cereals (possibly wheat)	<i>Spermophilus citellus</i> burrows were detected. Group of holes of 6 cm diameter was observed at the BVS site. Sightings of KPL004, KPL007, and KPL008 might all comprise holes of a single <i>Spermophilus</i> colony.
3	KPL008 (block R2/L2-R3/L3)	Between Nea Mesimvria and Agios Athanasios	361.2 (outside the 500 m zone)	Cropped cereals (possibly wheat)	<i>Spermophilus citellus</i> burrows were detected. Group of holes of 6 cm diameter was observed. Sightings of KPL004, KPL007, and KPL008 might all comprise holes of a single <i>Spermophilus</i> colony.
4	MM11 (block R7/L7-R8/L8)	Gefyra	367 (outside the 500 m zone)	Cropped wheat field	<i>Spermophilus citellus</i> burrows were detected. 16 holes were counted.
5	MM13 (block R8/L8-R9/L9)	West of Gefyra	368.2	Cropped wheat field	<i>Spermophilus citellus</i> burrows were detected, 7 holes were counted.
6	MM12 (block R9/L9-R10/L10)	West of Gefyra	368.3 (outside the 500 m zone)	Cropped wheat field	<i>Spermophilus citellus</i> burrows were detected, 7 holes were counted.
7	178	Eastern of Axios river	369.2	Fallow field (under cereal crop in the past) of short vegetation (Oat, wheat etc.)	<i>Spermophilus citellus</i> burrows were detected (8 large holes observed, 2 of them over 10 cm diameter).
8	MM14 (block R9/L9-R10/L10)	Axios river	369.2 (Outside the 500 m zone)	Dirt road	<i>Spermophilus citellus</i> burrows were detected, 8 holes were counted.
9	185	Axios river	369.8	Dirt road	Many holes of 6-7 cm diameter, characteristic pattern of the burrows <i>Spermophilus</i> constructs in that habitat type
10	168	Paralimni	391 (Outside the 500 m zone)	Meadow within Giannitsa plain	Several <i>Spermophilus citellus</i> burrows, animal seen by local
11	MM20 (block R94/L94-R95/L95)	South of Maniakio	453.8	Fallow field of short vegetation (under cereal crop in the past)	<i>Spermophilus citellus</i> burrows were detected. 4 holes of 7-8 cm diameter were counted.
12	MM21 (block R94/L94-R95/L95)	South of Maniakio	453.8	Meadow of medium inclination with low vegetation	<i>Spermophilus citellus</i> burrows were detected. 15-20 holes, over 7 cm diameter, were counted, most of them in the upper part of the hill where ground cover was denser.

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No.	GPS POINT	Geographical area	Approx. KP chainage	Habitat	General comments
13	MM23 (block R95/L95-R96/L96)	South of Maniakio	454.6	Fallow field of very low, sparse vegetation	<i>Spermophilus citellus</i> burrows were detected. Large group of 30-40 holes over 7 cm diameter was observed, several of them with animal faeces around.
14	MM33 (block R102/L102-R103/L103)	SE of Filotas	462.6	Cropped cereals' field	<i>Spermophilus citellus</i> burrows were detected. 5 holes over 7 cm diameter were counted
15	MM34,1 (block R103/L103-R104/L104)	West of Komnina	463.2	Cropped alfalfa field	<i>Spermophilus citellus</i> burrows were detected. Group of many holes was observed.
16	MM35,2 (block R104/L104-R105/L105)	West of Komnina	464	Cropped alfalfa field	<i>Spermophilus citellus</i> burrows were detected. Group of many holes was observed.
17	MM36 (block R104/L104-R105/L105)	West of Komnina	464.9	Cropped alfalfa field	<i>Spermophilus citellus</i> burrows were detected. 2 holes were counted.
18	KPL081 (block R111/L111-R112/L112)	Perdikkas	470.9	Meadow	On the main road next to a gas station and a nearby house, many holes and a large tunnel (>10 cm diameter) were observed. The colony surrounded the house and the gas station. Holes were detected in the garden behind the house but not in the vineyard AND within any remnant meadow surrounding the plot. Animals were observed every morning by the house and gas station owner. Sighting of the animal for approx. 5-10 min while entering a hole.
19	KPL083 (block R111/L111-R112/L112)	Perdikkas	471	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed. Extend of colony observed at KP081.
20	KPL084 (block R111/L111-R112/L112)	Perdikkas	471.6	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed. Sightings of KPL084, KPL085, KPL086 and KPL087 might all comprise holes of the same <i>Spermophilus</i> colony.
21	KPL085 (block R111/L111-R112/L112)	Perdikkas	471.6	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed. Sightings of KPL084, KPL085, KPL086 and KPL087 might all comprise holes of the same <i>Spermophilus</i> colony.
22	KPL086 (block R111/L111-R112/L112)	Perdikkas	471.6	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed. Sightings of KP084, KP085, KP086, and KP087 might all comprise holes of the same <i>Spermophilus</i> colony.
23	KPL087 (block R111/L111-R112/L112)	Perdikkas	471.6	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed. Sightings of KPL084, KPL085, KPL086 and KPL087 might all comprise holes of the same <i>Spermophilus</i> colony.
24	KPL090 (block R114/L114-R115/L115)	NW of Ptolemaida	474.9	Meadow	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed.

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No.	GPS POINT	Geographical area	Approx. KP chainage	Habitat	General comments
25	KPL094 (block R118/L118- R119/L119)	Drosero (south of lake Chimaditis)	479	Alfalfa field	<i>Spermophilus citellus</i> burrows were detected outside the 500 m zone, but probably the colony extends also within the 500 m zone. Holes detected at KPL094 and KPL095 belong to the same colony.
26	KPL095 (block R118/L118- R119/L119)	Drosero (south of lake Chimaditis)	479	Alfalfa field	<i>Spermophilus citellus</i> burrows were detected outside the 500 m zone, but probably the colony extended also within the 500 m zone. Holes detected at KPL094 and KPL095 belong to the same colony.
27	MP95	Southern of Galatia (south of lake Chimaditis)	481.5	At the edge of a dirt road	Single hole of <i>Spermophilus</i> next to the road
28	KPL096 (block R121/L121- R122/L122)	Galateia (south of lake Chimaditis)	481.5	Alfalfa field	<i>Spermophilus citellus</i> burrows were detected. Group of holes was observed.

Source: ERM field survey (2011, 2012)

### 3.2 Other Important Features

Evidence of presence of other species of Rodentia was recorded in 56 observation points. The most frequent were the *Microtus* species: in Greece the genus *Microtus* is represented by five species i.e. *M. guentheri*, *M. rossiaemeridionalis*, *M. subterraneus*, *M. felteni*, and *M. thomasi*, (Mitsainas et al 2008), whose distributions overlap with the study area and their macroscopic distinction is very difficult, if achievable. The rarest (considered “Endangered” according to the Greek Red Data Book and Data Deficient for IUCN) is *Microtus felteni*, a Balkan endemic species of which there are only few records, some recent ones from Vermio Mt. Nevertheless, to identify the species a karyological analysis is necessary, as a result only the presence of the genus can be certified along the TAP route.

Other rodents detected within the study area were *Talpa* sp. and *Rattus* sp. Western Macedonia falls within the range of two mole species: *Talpa caeca* (endemic of south Europe) and *Talpa stancovici* (Balkan endemic). Both inhabit deciduous woodlands, meadows and pastures and can be sympatric. Indeed, either of these species<sup>1</sup> or perhaps both are sure to inhabit the Project area but to distinguish between them special features of the skull need to be measured.

The ground squirrel was found to inhabit the same area with *Microtus* species in five sampling locations i.e. from KP 463 to KP 465 and at KP 453.8, where also hare’s (*Lepus europaeus*) faeces were found.

<sup>1</sup> To differentiate between species, it is necessary to perform chromosomal analysis and skull measurements

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## 4 CONCLUSIONS

### 4.1 Key Habitats within the Study Area

The ground squirrel seems to be distributed in two wider areas along the 500 m zone around the pipeline route, clearly separated geographically from each other:

- The eastern population ranges from Nea Mesimvria, NW of Thessaloniki, to the Valley of Axios River, north of Gefyra village. Although the number of colonies is unknown, the population there lies between KP 361.2 to KP 369.8, as shown in *Table 4-1*.
- The western population ranges between the lakes Vegoritida and Chimaditis, with colonies occurring from KP 453.8, south of Maniakio village to KP 481.5 close to Galateia village. This area is much larger than the eastern one and is very likely to host several colonies.

Two colonies detected within the Project working strip lie at KP 454.6 and KP 464.9, while three more in the KP 453.8, KP 462.6, KP 471.6 were located within 50 m from the pipeline and, thus is considered to be also vulnerable to the pipeline construction activities.

**Table 4-1 Spermophilus citellus colonies reports**

<i>Pipeline KP chainage</i>	<i>Spermophilus colony reports within the study area (July 2011, May 2012)</i>	<i>Distance to the pipeline</i>
361.2	2	89 m
367.0	1	432 m
368.2	2	168 m
368.3	1	528 m
369.2	1	986 m
369.8	1	58 m
391.0	1	2507 m
453.8	2	39 m
454.6	1	3 m
462.6	2	49 m
464.0	1	64 m
464.9	1	14 m
471.6	2	35 m
474.9	1	79 m
479.0	1	143 m
481.5	1	55 m
481.5	1	122 m

Source: ERM field survey (2011, 2012)

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A point of great interest is the results of the countercheck of the colonies detected in 2011, almost a year afterwards: The data presented in *Table 4-2* indicate a high turnover rate for several of the colonies along the Project route: a number of colonies for which there had been strong evidence in 2011 were not verified again in 2012. It is currently unknown if these observations in 2012 refer to temporary displacement of the colonies due to the late spring soil tilling for agricultural purposes or they indicate local extinction or movement of the animals from one year to the next.

**Table 4-2 Comparison of *Spermophilus citellus* colonies' present within the working strip or its immediate vicinity, between two successive breeding seasons (July 2011 and May 2012)**

Section	KP chainage (approx.)	Evidence of colony in 2011	Evidence of colony in 2012
Nea Mesimvria	361.2	yes	no data
Axios	368.2 – 369.8	yes	yes
Maniaki	453.8 – 454.6	yes	yes
Filotas	462.6 – 464.9	yes	Presence of colonies not confirmed
Perdikas	471.6 & 474.9	yes	yes (Presence of a subpopulation of the colony in KP 471.6 not confirmed) Colony in KP 474.9 possibly extinct
Drosero	479	yes	Presence of colony not confirmed
Galatia	481.5	yes	Presence of colony not confirmed

Source: *Spermophilus citellus* field survey (July 2011 and May 2012)

Regarding the results, the two main locations marked as important for the species conservation corresponds to the distribution range of the two populations recorded in the field:

- The eastern population, from KP 361.2 to KP 369.8, that is the village of Nea Mesimvria, to the valley of Axios River;
- The western population, from KP 453.8 to KP 481.5, that is south of Maniakio village to Galateia village, south of lake Chimaditis.

According to the literature data, the species has been reported in Macedonia in regions of Kozani, Thessaloniki, Imathia, Pella, Florina and Pieria, and Kastoria (see *Section 1*). However, apart from the agricultural area of the region of Thermi, no more ecological data are available about its habitat. In the region of Thermi, the species has been recorded in alfalfa cultivations and fallow fields. The occurrence of the ground squirrel in alfalfa cultivations and fallow fields has

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been verified also in the present study. By comparing the results of the field survey with the available literature data, it could be noted that field survey results come to verify the presence of the ground squirrel in some of the locations that the species presence had been referred to. The colonies found between Nea Mesimvria and Axios river lie within the broader central Macedonian region, which is mentioned by Youlatos (2008), and are close to the northern border of the Natura site of Axios, Loudias and Aliakmonas (Sfikas, 2004; Youlatos, pers.comm.). Also, the reports concerning the southern part of the village Maniakio support the presence of the species at the Vegoritida Lake, as is listed in the Natura 2000 factsheets (Sfikas, 2004). The rest of the colonies, although not mentioned in the literature, lie between Vegoritida Lake and Chimaditis Lake. In Kastoria Lake, which seems to be the western border of its range in Greece based on the bibliography, the species' presence was not verified in the field. However, in one of the investigated fields, 3-5 burrows that could be attributed to the ground squirrel were recorded, and information provided by local people give evidence of the presence of a *Spermophilus*-like animal; more data are needed to support this claim. Lastly, no colonies of ground squirrel were recorded within the study area that lies within the broader regions of Giannitsa, Kozani and Vermio, which are reputed to host ground squirrel colonies.

Monitoring studies concerning the occurrence of the European ground squirrel colonies are available from the populations of Czech Republic, Slovakia and Bulgaria. In all three cases, it seems that extinction rate of ground squirrel colonies is very high. For example, in Czech Republic, in 2008 the occurrence of the ground squirrel was verified only in 35 sites out of 45 sites for which the presence of the animal had been recorded or reported in 2002-2008 (Mateju *et al.*, 2008). Moreover, in Slovakia the extinction rate seems to be even greater. Comparing the occurrence of the species between 1996 and 2008 with its occurrence listed in older literature, Ambros (2008) found that the species had become extinct in the majority of the referenced localities (87%), and estimated that in the 120 localities where the species was registered, due to changes in farming practices, its populations will become also extinct within 3-4 years. Furthermore, a study conducted the period 2005-2008 in Bulgaria with the purpose to verify the presence of the animal in 90 historical localities of *S. citellus* colonies, revealed that 30% out of 90 investigated colonies had disappeared, 28% were vulnerable and only 42% were stable (Koshev, 2008). On the other hand, although there is evidence that ground squirrel can migrate and colonize other habitats (Mateju *et al.*, 2010), and establish new colonies (Koshev, 2008), the fragmentation of its habitat and the subsequent isolation of the colonies due to the lack of suitable corridors seem to be inhibitory factors for the migration of the species to other areas and

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the maintenance of the population in high and viable densities (Millesi et al., 2004; Turrini *et al.*, 2008). Thus, the turnover of the species within a few decades, or even in a few years as it occurred in the Czech Republic ground squirrel's populations (Mateju *et al.*, 2008), proved to be high.

This report shows that there are at least two population units along the current TAP alignment in central and western Macedonia. Neither the turnover of the Greek colonies of *S. citellus* nor their sensitivity to immediate disturbance during infrastructure works is known but it has been claimed that the last known colony of the ground squirrel in the National Park of Dadia became extinct in 1992, while formerly the species was widespread in the park (Catsadorakis & Bousbouras, 2010). A monitoring scheme following the BACI framework should be developed to assess in a quantitative way the status of colonies within the working strip or in its immediate vicinity just prior to construction. The 2011 – 2012 observations indicate a high turnover rate for several of these colonies which mean that current agricultural processes along the Project working strip may be adequate to ensure temporary displacement of the colonies during construction of the pipeline and no further mitigation measures may be required. A similar approach has already taken place in lower Austria and apparently has been successful in temporarily removing colonies outside the working strip with no need for further intervention. This however cannot be verified unless a monitoring scheme be developed at the site prior to construction.

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Date 06/2013

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