INSECT SUCCESSION ON DOG (*CANIS LUPUS FAMILIARIS* L.) CARCASSES IN SAMSUN PROVINCE, TURKEY

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ABSTRACT**:** This field study was carried out succession of insect in the Taflan at Samsun province (Turkey) in the period from June 2009 to May 2010 by using dog (*Canis lupus familiaris* L.) carcasses as a human model. Eight dog carcasses (20–35 kg) were employed in this field in four seasons. The aim of this study was to determine the forensically significant insect succession and seasonal distribution in Samsun province. In our study five decomposition stages were observed (fresh, bloated, active decay, advanced decay, dry). The carcasses decomposed more rapidly in summer and autumn but carcasses decayed slowly in winter and spring. Carcasses attracted 25 species of insect in our study. During this period, a lot of insects belonging to the following orders and families were collected: Diptera: Calliphoridae, Sarcophagidae; Coloeptera: Staphylinidae, Histeridae, Dermesitidae, Cleridae, Nitidulidae, Silphidae. In spring and autumn carcasses attracted a more different community of insects than winter-placed carrion. No Coloepter species were collected in the winter. Insect fauna and its seasonal differences in Samsun on dog carcasses were reported for the first time in this study, strengthening the need of further experiments in different regions of Turkey in order to forensic practice.

KEY WORDS*:* Forensic entomology, Insect succession, Decomposition, Turkey.

Decomposition is a main part of all life cycles and a natural process, which is happening all around everyday and responsible for the recycling of organic material to the ecosystem on earth (Kocarek, 2003). Following death, insects are usually the first to reach a corpse and colonize in a predictable sequence (George et al., 2012; Kyerematen et al., 2012). Insects are the most important and essential components of the decomposition process. Every decomposition stage is attractive to diverse species of insect and (Horenstein & Linhares, 2011; Horenstein et al., 2010) and each group of Insects plays different roles during decomposition (Galal et al., 2009). Insect successions on carcass are usually the source of information with criminal events (Horenstein et al., 2010; Horenstein & Linhares, 2011; Kumar et al., 2011). Insect may be classified into four ecological categories comprising: necrophages; parasites and predators of necrophagous species; omnivores, and incidentals (Horenstein & Linhares, 2011; Horenstein et al., 2010). Forensic entomology is the use of the insects that feed on carcass to aid criminal investigations (Galal et al., 2009; Okiwelu et al., 2008; Mello & Coelho, 2009; Stefano, 2004; Wolff et al., 2001). Entomological evidence is useful for estimating postmortem interval (PMI) (Rodriguez & Bass, 1983; Kulshrestha & Chandra, 1987; Greenberg, 1991; Anderson, 1995; Benecke, 1998; Amendt et al., 2004), determining manner and cause of death, place of death, post-mortem transfer (Pai et al., 2007; Eberhardt & Eliot, 2008; Bonacci et al., 2009), toxicological investigations (Bonacci et al., 2009; Eberhardt & Eliot, 2008; Pai et al., 2007; Manhoff et al., 1991; Nolte et al., 1992; Introna et al., 2001; Bourel et al., 2001) and estimating period of neglect in the elderly or children (Bonacci et al., 2009; Eberhardt & Eliot, 2008; Fieguth et al., 1999; Benecke & Lessig, 2001).

Patterns of insect succession and decomposition may chance according to the geographical region and environmental conditions (like temperature and humidity) and environmental conditions such as temperature and humidity (Horenstein & Linhares, 2011; Horenstein et al., 2010). As such, succession data obtained from corpses at one geographic location cannot be carried out to other locations because every site has different ecological characteristics (Okiwelu et al., 2008; Sharanowski et al., 2008; Tabor et al., 2005; Wang et al., 2008).

Several studies of arthropods on carrion have been applied in some regions of the world for forensic purposes (Wolff et al., 2001; Anderson, 1995; Eberhardt et al., 2008; Sharanowski et al., 2008; Tabor et al., 2005; Wang et al., 2008; Sukontason et al., 2001; Sabanoğlu & Sert, 2010; Ozdemir & Sert, 2009) but studies in Turkey are rare. However, there are no published data on the insects' succession in Samsun. The objective of this work was to determine insect succession and seasonal differences in insect activity on carrion decomposing in the four different seasons of the year in Samsun, Turkey. This entomological information may be used as reference data in forensic investigations

MATERIALS AND METHODS

Study Site

Samsun province is located in north of (Turkey) and big urban city. Samsun has Mediterranean climate. The province has four distinct seasons: winter, spring, auntumn, summer. According to the weather station, summers are hot and dry, winters are cool and rainly, spring and auntumn are mild and rainly. Annual rainfall is 800-850 mm/year. The experiments were carried out in four different seasons between June 2009 and July 2010. The study area was at Taflan, Samsun, Turkey (41° 26' N; 36° 0.8' E) and the area is sea level and 500 m away from sea side. In its native form, experimental area is characterized by, broad-leaved herbs, mixed grasses and deciduous shrubs. There are agricultural areas around the study site. The animal model used for this study was the dog (canis lupus familiaris l.) that had died of natural causes from animal shelter of municipality. We used 8 dog (*Canis lupus familiaris* L.) carcasses, weighing between 20 and 35 kg (mean±25.5 kg). Carcass were weighted and put in semi-transparent garbage bags to prevent entry by arthropods. Within 1h, the carcasses were transported to the study site, removed from their respective bags and placed directly on the ground. To prevent disturbance by scavengers, the carcasses were enclosed within a removable 1.30 cm×90 cm×90 cm wooden cage covered with wire mesh 2.5 cm mesh 2.5 cm wide all sides except the underside. Air temperatures were measured in the study area and digital thermometers were used record body temperature of carcass. Data on temperature and humiditywere obtained from local weather station. All dogs were placed on study site in four seasons (Table 1), two dogs were used every seasons and left to decompose naturally.

Sampling and Identification

The study sites were visited daily in summer and autumn and three times a week in winter and spring. The studies were conducted at the warmest time of the day when insects are most active. During each visit, the state of the carcass, weather conditions and insect activity were observed and recorded. A photographic record was also maintained for the duration of the study. Representative samples of adult and immature were collected daily from on, in and under the carcasses and using the forseps, spoons and hand. Samples of larvae were divided in two where half were killed at the site by immersion in near-boiling water and preserved in 70% ethanol and half were taken to the laboratory for rearing. The rearing of larvae was for confirmatory identification purposes. Larvae were placed on a small piece of raw chicken liver (approximately 10 g) and then a 3 cm layer of vermiculite was added to 200 ml clear plastic containers. Pieces of furnished with small holes for air circulation, were used to cover containers. Containers were held at room temperature (i.e., 22–24◦C) with a light: dark regime of 12:12 hours. Containers were checked twice daily for the presence of adult blow flies. Some of adult specimens were put in 70% ethanol. The remainder was directly killed in cyanide jars. Ethanol-killed insects were preserved in plastic specimen containers and cyanide killed insects were pinned and put in the collection for identification and observation. Each sample box was labeled accordingly. Taxonomic determination was made by using current keys (Whitworth et al., 2006; Riberio & Carvello, 1998; Carvalho & Mello-Patiu, 2008; Pape, 1996; Dekeirsschieter et al., 2011; Dillon & Dıllon, 1972; Hall, 1977; White, 1985; Almeida & Mise, 2009; Háva, 2004).

RESULTS

The Decomposition Process of the Carcasses

Climatological data was obtained from a weather station. During the working periods, average air temperature and relative humidity were recorded as shown in Table 2. Average daily air temperatures and relative humidity were 23.0±2.0°C and 73.0±6.3%, respectively during summer months, 16.8±7.9°C and 73.9±0.7% during auntum months, 10.6±2.6°C and 62.3±17.6% during winter months, 13.5±7.9°C and 79.4±10.1% during spring months. The highest air temperature was 27.1°C in summer, 25.6°C in auntum, 20.0°C in winter and 21.7°C in spring (Table 2). In this study, five stages of decomposition were recognized (fresh, bloated, active decay, advanced decay and dry) from descriptions provided by Carvalho et al. (de Carvalho et al., 2004).

The fresh stage lasted on average 1 day in summer, 1.5 days in autumn, 4.5 days in spring and 5 days in winter (Fig. 1). The bloated stage lasted on average 1.5 days in summer and autum, 7 days in winter and 6 days in spring. The active decomposition stage lasted on average 8 days in summer, 30 days in winter, 26 days in spring and 10 days in autumn. Advanced decomposition stage lasted on average 35 days in spring, 12 days in summer and 30 days in autumn (Fig. 1). Carcasses decayed at a faster rate in summer and autumn seasons in Samsun (Table 2, Fig. 1). In summer, carcasses took only 23 days to reach the dry stages when average daily temperatures were more than 25°C (Table 2, Fig. 1). In contrast, during winter, 86 days were required for carcasses to reach the dry stage under the lowest daily temperature for the year (Table 2, Fig. 1). As it is known that the decay process of carcasse at different rates and the patterns of insect succession in different season (Sabanoğlu & Sert, 2010; Ozdemir & Sert, 2009; de Carvalho et al., 2004; Prado et al., 2012; Tantawi et al., 1996).

Insect Succession

In this study, a total of 20 species of Coleoptera, belonging to 6 families and total of 5 species of Diptera, belonging to 2 families, were collected from carcasses during one-year period. The following species were identified: Coloeptera: *Creophilus maxillosus (*Staphylinidae), *Philonthus concinnus*, (Staphilinidae), *Philonthus politus* (Staphilinidae)*, Aleochara intricata* (Staphilinidae), *Aleochara lata* (Staphilinidae), *Ontholestes murinus* (Staphilinidae), *Dermestes frischii* (*Dermesi*dae). *Dermestes maculatus, Dermestes undulatus* (*Dermesi*dae), *Margarinotus brunneus* (Histeridae), *Saprinus subnitescens* (Histeridae), *Saprinus vermiculatus* (Histeridae), *Saprinus caerulescens* (Histeridae), *Necrobia rufipes, Necrobia violacea, Necrobia ruficollis* (Cleridae), *Thanatophilus rugosus* (Silphidae), *Thanatophilus sinuatus* (Silphidae), *Necrodes littoralis* (Silphidae), *Nitidula flavomaculata* (Nitidulidae) and Diptera: *Lucilia sericata* (Calliphoridae), *Chrysomya albiceps* (Calliphoridae), *Calliphora vomitera* (Calliphoridae), *Calliphora vicina* (Calliphoridae), *Sarcophaga argyrostoma* (Sarcophagidae). The succession patterns for forensically significant insects on carcasses are depicted in Table 3. Most of the insects were found all throughout the year and there was obviously difference in species between the four seasons, although Coloeptera taxa were absent in winter.

The summer experiment was carried out from Jully 18 to September 10 2009. Species of Diptera increased from the fresh stage, reached a maximum in the active decomposition stage and declined in the middle of advanced stage and they were absent in dry stage. Within an hour, blow flies (Calliphoridae) and flesh flies (Sarcophagidae) were observed visiting the dog carcass. *Chrysomya albiceps* was the dominant species on carcasses in summer and autumn, showing low incidence during spring and constituted the primary factor in the decomposition process. Other early colonisers, *Sarcophaga argyrostoma* arriving during fresh stages of decomposition in summer. *Sarcophaga argyrostoma* was observed only summer season in Taflan. In active decomposition stage, more Dipteran groups were present (Calliphoridae and Sarcophagidae) (Tables 4 and 5). Some characteristic Coleoptera appeared (Dermesidae, Staphylinidae and Histeridae) during active decomposition stage. *Creophilus maxillosus* and *Dermestes frischii* started to appear; on day 3. *Saprinus subnitescens Dermestes maculatus* and *Dermestes undulatus* started to appear; on day 8 after death. In the advanced decomposition stage Diptera decrease significantly (Tables 4 and 5). Staphylinidae, Histeridae and Dermesidae were Coleoptera, continued to be present this stage. *Margarinotus brunneus* started to appear; on day 15. On day 18, *Necrobia rufipes, Necrobia violacea* were first collected on carcass and peresent during dry stage. Genereally and species of Coloeptera that was observed in active and continued to be present in dry stage (Table 3) but some species of Coloeptera were collected during advanced decomposition (except of winter season). The beginning of the dry stage in summer was difficult to distinguish from the end of the advanced decay stage.

The autumn experiment was carried out from September 11 to November 20 2009. Two species from Calliphoridae family were identified on the dog carcasses; *Lucilia. sericata* and *Chyrosmya albiceps* within fresh and bloated stage (Tables 4 and 6). *Lucilia sericata* was seen only this season. *Chyrosmya albiceps* was an abundant primary coloniser of carcases. In the active decomposition stage Dipteran and Coloepteran groups were peresent. The number of Coleopterans increased considerably during the active decomposition stage. On day 3, Staphilinidae, Cleridae, Histeridae and Dermesidae started to appear (Tables 3, 4 and 6). *Creophilus maxillosus*, *Philonthus concinnus*, *Philonthus politus, Aleochara intricata, Saprinus vermiculatus* and *Margarinotus burunnes Saprinus caerulescens, Dermestes frischii*, *Dermestes undulatus, Necrobia rufipes, Necrobia violacea* and *Necrobia ruficollis* were observed during the active decomposition stage and continued to be found during dry stage (Tables 4 and 6).

The winter experiment was carried out from November 22 to March 20 2010. In fresh and bloated stage, *Calliphora vicina* were observed on the carcasses. In the active decomposition stage *Calliphora vicina* continued to be found and *Calliphora vomitoria* started to appear; on day 30. Calliphoridae were peresent during advanced decomposition stage. During the dry stage two Calliphorids disappeared. *Calliphora vicina* was the dominant species on carcasses in winter. No Coloepter samples were observed on carcasses in winter (Tables 4 and 7).

The spring experiment was carried out from March 24 to July 15 2010. *Calliphora vicina* were collected during the fresh stage. In bloated stage, *Calliphora vicina* were collected and *Calliphora vomitoria* started to appear; on day 9. In the active decomposition stage Calliphoridae were peresent. On day 13 *Creophilus maxillosus, Aleochara lata*, *Dermestes frischii*, *Saprinus vermiculatus*, *Necrobia violacea, Necrobia rufipes, Thanatophilus rugosus, Thanatophilus sinuatus, Necrodes littoralis*, *Nitidula flavomaculata* species started to appear. In the study, *Nitidula flavomaculata* is the only Nitiduladae species detected. *Chyrosmya albiceps* started to appear on day 30 but it collected lower frequencies. Fly activity decreased in advanced decomposition stage. Staphylinidae, Histeridae and Dermesidae continued to be present this stage. On day 60 *Saprinus caerulescens*, *Ontholestes murinus, Philonthus concinnus* started to appear (Tables 4 and 8). All species of Coloeptera were observed during dry stage. But insect diversity decreased during the dry stage.

DISCUSSION

Internationally, decomposition studies have been carried out on cats (Rodriguez & Bass, 1983), dogs (Introna, 2001; Sabanoğlu & Sert, 2010; Ozdemir & Sert, 2009; Anderson, 1996), pigs (Sabanoğlu & Sert, 2010), guinea pigs (Bourel et al., 2001), mice (Whitworth , 2006), foxes (Riberio & Carvello, 1998; Carvalho & Mello-Patiu, 2008), lizards and toads (Pape, 1996), turtels (Bonacci et al., 2009), rabbits (Manhoff et al., 1991), elephants (Pai et al., 2007), impala (Eberhardt & Eliot 2008) and humans (Benecke, 1998; Anderson & Van Laerhoven 1996). Field study on the process of decomposition and insects' succession was conducted, for the first time in Samsun. The results indicate that carrion decays very quickly in summer but quite slowly in winter. It could be said that decomposition rates are directly proportional to temperature (Goyal, 2012).

Insects arrive on a corpse in a predictable sequence depending on the stages of decomposition. Diptera is the first insect group to be attracted (Ozdemir & Sert, 2009; Byrd & Castner, 2001) and the Coleoptera appeared later, continued to be present dry stage, as was declerad by Anderson and VanLaerhoven (1996), Wolff et al. (2001), Carvalho et al. (2004).

In spring, summer and auntum Diptera and Coloeptera were the most abundant groups and Coleoptera were prevalent in the active and advanced decomposition stage in all season except of winter season (Table 4). In winter, insect diversity was reduced, only two species (Calliphoridae) were found. Calliphoridae family was the first colonizers and played a major role in carcasses decay (Table 7). Four species of Calliphoridae were observed in all seasons. Among the two Calliphorid species that were best-represented during the summer and auntum in Samsun. *Chrysomya albiceps* was the most abundant Calliphorid species during the summer and auntum, especially in the summer, followed by autumn. The species was first seen at the on May 20 and existed until November 26. *Chrysomya albiceps* females did not lay egg in winter and it was observed low frequency during the spring in Samsun (Table 4). *Calliphora vicina* and *Chrysomya albiceps* were the species that had the longest duration on the dog carcasses in this study Lucilla sericata was seen auntumn but absent in other seasons. Other the two Calliphorid species are *Calliphora vicina* and *Calliphora vomitoria* that are a typical species of cold habitats. Therefore *Calliphora vicina* was the dominant species during winter followed by spring in Samsun. *Calliphora* *vicina* was present on the dog carcasses from November 10, 2009 until May 10, 2010. The seasonal distribution of *Calliphora vicina* showed that it is a species adapted to low temperatures, reaching a peak in winter, disappearing during the summer and reappearing in autumn and spring in low percentages. *Calliphora vomitoria* was collected during the winter and spring and it was collected lower frequencies than *Calliphora vicina* during this season (Table 5). Other Diptera species of *Sarcophaga argystoma* was collected during the summer but it was absent in other seasons. The similiar observation was also made by Tantawi et al. (1996), Sabanoğlu (2010), Introna et al. (1991). *Calliphora vomitoria* and *Calliphora vicina* was observed during winter, auntum and spring. Introna et al. (1991) stated that *Calliphora vicina* was observed during autumn.

20 species of Coloeptera were observed in our study. Among Coleoptera, Staphylinids were the first attracted group, followed by Clerids, Dermestids and Histerids during all season. In addition these species, Nitidulids and Silphids were observed during spring in our study. Species of Coloeptera were observed during the active, advanced decay stages and dry stage but some of species that appeared in active and advanced decomposition stage were absent in dry.

Staphylinidae was the family having the most abundant of species on carcasses and six Staphylinidae were recorded. Three Silphidae, Cleridae, Dermesidae and four Histeridae species were recorded in this study during three seasons (Table 4). These findings are consistent with the findings of Reed (1958), Carvalho et al (2004), Özdemir (2009), and Tantawi et al. (1996). Some species of Coloeptera were observed only in particular season *Philonthus pollitus, Saprinus subnitescens* and *Necrobia ruficollis* only appeared in auntum, *Dermestes maculatus* in summer, *Ontholestes murinus, Necrodes littoralis, Thanatophilus sinuatus, Thanatophilus rugosus, Nitidula flavomaculata* in spring. Other species of Coloepter were observed during summer, spring and auntumn.

CONCLUSIONS

Insect succession is a helpful tool in forensic investigations. In this study we recorded succession of insects on dog carcases and seasonal distribution; this succession is determined by two orders, Diptera and Coloeptera. Diptera colonize the carcass from initial stages of decomposition to dry stages, Coloeptera were present during later stages of decomposition. We observed that climate factors effect insect succession. Our findings about the stage of decay and insect succession are similar to the results obtained in other studies (Sabanoğlu & Sert, 2010; Prado et al., 2012; Reed, 1958). This is the first study done in Turkey on the Coleopteran and Diptera fauna of carcasses in same time during one year and this study provides helpful data on forensic entomology in Samsun. Turkey have different types of geoclimatic region, more detailed and comprehensive work are required to determine species and seasonal distrubition in each geografic region in the future.

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Table 1. Date of placement of dog carcasses.

Season	**Date**	**Dogs**
Summer	**Jully 18, 2009**	**1**
	August 15, 2009	**1**
Autumn	**September 11, 2009**	**1**
	October 6, 2009	**1**
Winter	**November 22, 2009**	**1**
	December 23, 2009	**1**
Spring	**March 24, 2010**	**1**
	April 5, 2010	**1**

Table 2. Climatological data (mean ± SE) recorded during experimental periods.

		Temperature(◦C)			Humidity (%)		
Season	Carcasses	Max.	Min.	Ave[†].	Max.	Min.	Ave
Summer	2	27.1	18.9	23.0±2.0	86.7	48	73.0±6.3
Autumn	2	25.6	8.6	16.8±7.9	92.3	42.3	73.9±0.7
Winter	2	20.0	0.8	10.6±2.6	91	18	62.3±17.6
Spring	2	21.7	4.6	13.5±7.9	89.3	58	79.4±10.1

[†]Ave. is the daily average temperature.
[‡]Means in a row followed by the same letters are

Table 3. Insects of forensic importance species collected on carcasses in Samsun.

Order	**Family**	**Species**
Diptera	Calliphoridae	*Chrysomya albiceps* (Wiedemann, 1819)
		Lucilia sericata (Meigen, 1826)
		Calliphora vomitoria (Linnaeus, 1758)
		Calliphora vicina Robineau-Desvoidy, 1830
	Sarcophagidae	*Sarcophaga argyrostoma*)(Robineau-Desvoidy, 1830)
Coloeptera	Staphylinidae	*Creophilus maxillosus* (Linnaeus, 1758)
		Ontholestes murinus (Linnaeus, 1758)
		Aleochara lata (Gravenhorst nec Kirby 1832, 1802)
		Philonthus concinnus (Gravenhorst, 1802)
		Philonthus politus (Linnaeus, 1758)
		Aleochara intricata (Mannerheim, 1830)
	Silphidae	*Thanatophilus sinuatus* (Fabricius, 1775)
		Necrodes littoralis (Linné, 1758)
		Thanatophilus rugosus (Linnaeus, 1758)
	Histeridae	*Saprinus vermiculatus* (Reichardt, 1923)
		Saprinus caerulescens (Hoffmann, 1803)
		Margarinotus burunnes (Fabricius, 1775)
		Saprinus subnitescens (Bickhardt, 1909)
	Dermestidae	*Dermestes frischii* (Kugelann, 1792)
		Dermestes undulatus (Brahm, 1790)
		Dermestes maculatus (DeGeer, 1774)
	Cleridae	*Necrobia rufipes* (De Geer, 1775)
		Necrobia violacea (Linnaeus, 1758)
		Necrobia ruficollis Fabricius, 1775
	Nitidulidae	*Nitidula flavomaculata* Rossi, 1790

Table 4. Insect groups in the different seasons and in every decomposition stage.

Seasons	Summer					Auntumn					Winter					Spring				
Species	F	B	Ac	Ad	DR	F	B	Ac	Ad	DR	F	B	Ac	Ad	DR	F	B	Ac	Ad	DR
Chrysomya albiceps	×	×	×	×		×	×	×	×											
Lucilla cericata						×	×	×	×											
Calliphora vicina											×	×	×	×		×	×	×	×	
Calliphora vomitera													×	×			×	×	×	
Sarcophaga argyrostoma	×	×	×	×																
Creophilus maxillosus			×	×	×			×	×	×								×	×	×
Philonthus concinnus								×	×	×									×	×
Philonthus politus								×	×	×										
Aleochara intricata								×	×	×										
Aleochara lata																		×	×	×
Ontholestes murinus																			×	×
Dermestes frischii			×	×	×			×	×									×	×	×
Dermestes maculatus			×	×	×															
Dermestes undulatus			×	×	×			×	×											
Saprinus subnitescens			×	×	×			×	×	×										
Margarinotus brunneus				×	×			×	×	×										
Saprinus vermiculatus								×	×	×								×	×	×
Saprinus caerulescens								×											×	×

Necrobia violacea				×	×			×	×									×	×	×
Necrobia rufipes				×	×			×	×									×	×	×
Necrobia ruficollis								×	×											
Thanatophilus rugosus																		×	×	×
Thanatophilus sinuatus																		×	×	×
Necrodes littoralis																		×	×	×
Nitidula flavomaculata																		×	×	×

F: fresh stage, B: bloated stage, AD: active decay stage, AdD: advanced decay stage, DR: dry stage.

Table 5. Distribution of identified species during summer.

Species	**June**				**July**				**August**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
C.albiceps	■						■	■	■	■	■	■
S. argyrostoma							■	■	■	■	■	■
C. maxillosus	■	■						■	■	■	■	■
D. frischii	■	■						■	■	■	■	■
D.maculatus								■	■	■	■	■
D. undulatus	■	■						■	■	■	■	■
N. violacea	■	■							■	■	■	■
N. rufipes	■	■							■	■	■	■
M brunneus	■	■							■	■	■	■
S.subtinescens								■	■	■	■	■

Table 6. Distribution of identified species during autumn.

Species	**September**				**October**				**Novemb er**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
C.albiceps	■	■	■	■	■	■	■	■	■	■		
L. sericata	■	■	■	■	■	■	■	■	■	■		
P. concinnus			■	■	■	■	■	■	■	■		
C. maxillosus	■		■	■	■	■	■	■	■	■		
P. politus			■	■	■	■	■	■	■	■		
A. intricata			■	■	■	■	■	■	■	■		
D. frischii	■		■	■	■	■	■	■	■	■		
D. undulatus	■		■	■	■	■	■	■	■	■		
M. brunneus	■		■	■	■	■	■	■	■	■		
N. violacea	■		■	■	■	■	■	■	■	■		
N. rufipes	■		■	■	■	■	■	■	■	■		
N.ruficollis			■	■	■	■	■	■	■	■		

Table 7. Distribution of identified species during winter.

Species	**December**				**January**				**Februar y**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
C. vicina	■	■	■	■	■	■	■	■	■	■	■	■
C. vomitera				■	■	■	■	■	■	■	■	■

Table 8. Distribution of identified species during spring.

Species	March				April				May			
	1	2	3	4	1	2	3	4	1	2	3	4
C.albiceps												
C. vicina												
C. vomitera												
C. maxillosus												
A. lata												
P. concinnus												
O.murinus												
D. frischii												
S. caerulescens												
S. vermiculatus												
M. brunneus												
N. violacea												
N. rufipes												
T. sinuatus												
T. rugosus												
N. flavomaculata												

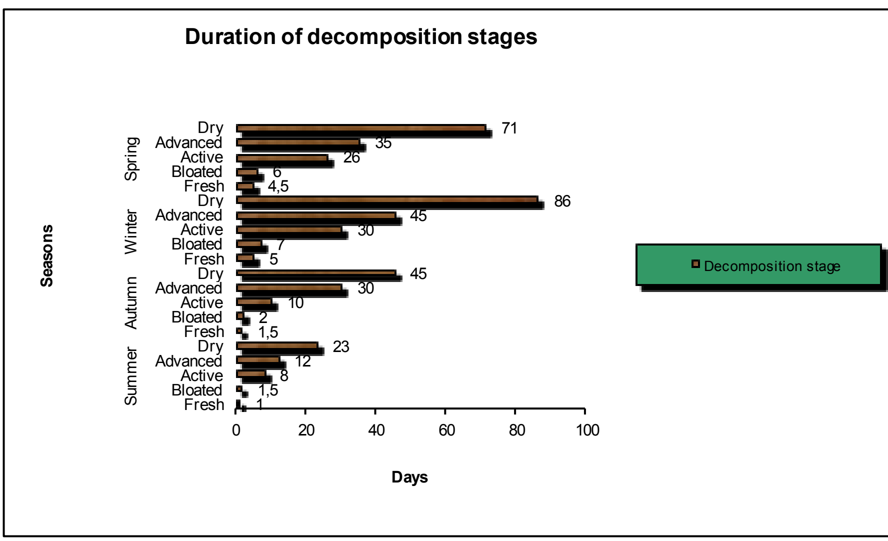

Figure 1. Decomposition stage with duration in season.