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Seasonal dynamics of forest spiders (Arachnida: Araneae) in the temperate zone of the Basque Country and Navarra (northern Spain)

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Abstract

The aims of this research are to determine the time of year with the highest species richness to avoid whole-year samplings in future studies, and to contribute to the seasonal dynamics and faunistic knowledge of the spider fauna of the study area. Hence, it summarizes temporal changes in species richness and seasonal activities of spiders collected in several temperate forests sampled using different methods. Results show the May-June transition as the period with the peak in species richness. However, this maximum takes place earlier in the epigeal stratum (May), and later on tree trunks (June). Additionally, lower strata show higher representation of species of long mating periods. Three species, *Centromerita bicolor*, *Micrargus apertus* and *Midia midas* are new records for Iberian fauna, while *Peponocranium ludicrum* is a new genus record for Spain. Seasonal activities of *Nemesia simoni* and *Labulla flahaulti* are described for the first time. Data obtained in two of the sampled forests will make it possible to evaluate the efficiency of future short-term collecting protocols for the study area.

• **Key words:** Araneae, seasonal activity, temperate forests, species richness, Spain.

Resumen

Los objetivos del presente trabajo son determinar la época del año que registra el mayor número de especies a fin de evitar muestreos de ciclos anuales completos en estudios futuros y contribuir al conocimiento faunístico y de las dinámicas estacionales de la araneofauna del área de estudio. Para ello, se compendia las variaciones temporales de la riqueza específica y de las actividades estacionales de las arañas capturadas en varios bosques templados muestreados a través de distintos métodos. Los resultados determinan la transición entre Mayo y Junio como el periodo que presenta el máximo de riqueza específica. Sin embargo, este máximo tiene lugar antes en el estrato epigeo (Mayo) y más tarde (Junio) en los troncos de los árboles. Además, los estratos más bajos muestran una mayor representación de especies de periodos de reproducción largos. 3 nuevas especies, *Centromerita bicolor*, *Micrargus apertus* y *Midia midas*, se citan para la Península Ibérica y un nuevo género, *Peponocranium ludicrum*, para España. Las actividades estacionales de

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Nemesia simoni y *Labulla flabaulti* se describen por primera vez. Los datos obtenidos en dos de los bosques muestrados permitirán evaluar la eficacia de futuros protocolos de recolección a corto plazo para el área de estudio.

• **Palabras clave:** Araneae, actividad estacional, bosques templados, riqueza específica, España.

Laburpena

Lan honen helburua, aztertzen den eremuan armiarma-fauna espezie kopuru handiena urtearen zein sasoietan ematen den zehaztea da, hurrengo azterketetan urteetako ziklo osoetan laginketa neketsuak egin beharra ekiditeko, ezagutza faunistikoan eta urte-sasoien zehar ematen den dinamika ezagutzen laguntzearekin batera. Horretarako, metodo desberdinak erabiliz lagindu diren hainbat baso epeletan harrapatutako armiarmak aurkezten duten aberastasun espezifikoa eta urte-sasoietan erakusten dituzten jarduerak aurkezten dira. Emaitzen arabera, maiatzetik ekainerako bitartea da aberastasun espezifiko handieneko epea. Dena dela, gehiengo hau geruza epigeoan lehenago ematen da (maiatza) eta beranduago (ekaina) zuhaitzen enborretan. Gainera, beherago dauden geruzak, ugalketa epealdi luzeagoak dituzten espezie gehiago dituzte. Iberiar Penintsularako hiru espezie berri, *Centromerita bicolor*, *Micrargus apertus* eta *Midia midas*, eta, Espainiarako, genero berri bat, *Peponocranium ludicrum*, aipatzen dira. *Nemesia simoni* eta *Labulla flabaulti*-k urte-sasoietan dituzten jarduerak lehendabizikoz deskribatzen dira. Lagindu direneko bi basoetan lortutako datuei esker, epe motzean eta azterketa eremurako, etorkizuneko bilketarako protokoloen eraginkortasuna neurtu ahal izango dugu.

• **Gako-hitzak:** Araneae, urte-sasoietako jarduera, baso epelak, aberastasun espezifikoa, Espainia.

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Introduction

Registering the entire biological diversity at regional scale is an impossible task, whatever economic and time resources are available, since biological diversity is constantly changing. The use of surrogate taxa as biodiversity indicators of a specific area has been proposed as a way of addressing this problem and facilitating biodiversity management and conservation policies (WILLIAMS *et al.*, 1997; VANCLAY, 2004). Spiders are often used as biodiversity indicators for the following reasons (MARC *et al.*, 1999; PLATNICK, 1999; MAELFAIT *et al.*, 2004; PEARCE & VENIER, 2006): they show high species richness, play an important role in terrestrial ecological webs, are of economic interest, are easy and inexpensive to sample (yielding quantitative analyzable results), their taxonomy is reasonably well known in developed countries, and their communities are sensitive to environmental change.

Knowledge of spider fauna is far from being complete both in the Iberian Peninsula (MORANO, 2004; CARDOSO, 2008) and in the area covered by this study (CASTRO, 2004a). To counter this lack of information, maximizing economic and time resources, intensive short-time sampling protocols have been developed in other countries (CODDINGTON *et al.*, 1991, 1996; SORENSEN *et al.*, 2002; SCHARFF *et al.*, 2003; CARDOSO *et al.*, 2008). The first step in applying these methods is to conduct sampling programs encompassing entire year cycles to ascertain at what time of year the highest spider diversity is found (CARDOSO, 2004, CARDOSO *et al.*, 2007).

Potentially, almost the entire surface of the study area would be taken up by forest ecosystems (ASEGINOLAZA *et al.*, 1996). Forestry covers 61% of the Basque Country's temperate area, although more than half of the forest surface is occupied by plantations of exotic species (DEPARTAMENTO DE AGRICULTURA, PESCA Y ALIMENTACIÓN 2007). The situation in the temperate zone of Navarra is similar, though native species predominate (ICONA, 1994). In any case, most indigenous forests are exploited for sylvicultural and shepherd activities (LOIDI & BASCONES, 1995; ASEGINOLAZA *et al.*, 1996). In this regard, knowledge of spider communities in temperate forests can be applied for designing suitable biodiversity conservation programs in the study area, as is happening in other European regions (RIECKEN, 1998; DE BAKKER *et al.*, 2002).

This study therefore analyses collections of woodland spiders available for the study area with the following objectives: 1) To determine which period of the year would be most suitable for intensive short-time sampling programs yielding a representative range of regional spider fauna, and 2) to contribute to an understanding of seasonal dynamics and a faunistic knowledge of spider fauna in the study area.

STUDY AREA

The data came from four independent studies whose locations are summarized in Table I. All them show oceanic temperate climate (RIVAS-MARTINEZ, 1994). The characteristics of the different forest sites sampled are described below:

Site	Town/Province	U.T.M. Coordinates	Altitude (m)	Orientation	Termotipe/ Ombrotipe
Gorbea	Areatza-Villaro/Bizkaia	30TWN1673	400-510	Diverse	C/Hi
Artikutza	Goizueta/Navarra	30TWN9786	575-650	SW	C/U
Evergreen oak forests	Arrasate/Gipuzkoa	30TWN4070	450	E	C/Hi
	Ataun/Gipuzkoa	30TWN6760	390	W	C/Hi
	Deba-Itziar/Gipuzkoa	30TWN5591	310	E	C/Hi
	Mendaro/Gipuzkoa	30TWN4990	225	SW	C/Hi
	Zumaia/Gipuzkoa	30TWN6194	20	SW	T/H
	Larraun/Navarra	30TWN8464	312	SE	C/Hi
Igara	San Sebastián/Gipuzkoa	30TWN7894	50-70	E	T/Hi

Table I.- Location and climate of the studied sites. Abbreviations: C = coline, T = thermocoline, Hi = lower hyperhumid, U = ultrahyperhumid, H = upper humid.

Gorbea: Samples were taken in the area of Upomakatxa, from seven forest stands near to each other: five plantations of *Pinus radiata* D. Don (three 30 year-old plantations, one 18-year-old and one 8-year-old), and two indigenous stands—one small beech forest (*Fagus sylvatica* L.) and one young deciduous broadleaf mixed forest (with predominance of *Quercus robur* L., *Castanea sativa* Miller and *Corylus avellana* L.). The main objective of this study was to analyse the impact of exotic pine forest plantations on soil invertebrate fauna. Livestock was commonly present in all stands. More details on the sampling design and first results obtained are given in BARRAQUETA (1985, 1988, 2001).

Artikutza: Samples were taken from a 5 ha interface between a beech forest and a deciduous broadleaf forest (with predominance of *Quercus robur* L.). This stand was in a regeneration process after a plantation of Scots pine (*Pinus sylvestris* L.) had lain abandoned for 70 years. The forest contained a large amount of dead wood. Livestock was also present at this site. The original purpose of this research was to study the spatial activity patterns of several families of Hymenoptera (MARTÍNEZ DE MURGUÍA, 2002). More details of the study area may be found in MARTÍNEZ DE MURGUÍA *et al.* (2001, 2002).

Cantabrian evergreen oak forests: This sampling program was carried out in the six most representative Cantabrian evergreen oak forests in the provinces of Gipuzkoa and Navarra. This type of forest is characterized by the dominance of the holm oak *Quercus ilex* L. subsp. *Ilex*. At the time of the research, the stands were in a recovery process due to the abandonment of charcoal extraction and their development on lands of little economic interest. Although the spider community of these forests had already been described (CASTRO, 2004b), the seasonal dynamics of the species had not been analysed, and they were therefore included in this work. A detailed description of the sampled stands may be found in CASTRO (2004b).

Igara: This sampling took place in a small eutrophic alder forest (with dominance of *Alnus glutinosa* (L.) Gaertner) located outside the city of San Sebastián. The forest was unexploited, but at a young stage, with no tree measuring more than 35 cm in diameter at breast height. The understorey was very dense, with several trees covered by ivy (*Hedera helix* L.) and the presence of scattered fallen trees. The main aim of this sampling was to compare two different bark trap designs to study trunk-dwelling spiders. The results are currently being analysed and are to be published shortly.

MATERIALS AND METHODS

Sampling methods: Table II summarizes the different sampling programs conducted at each forest site. Spider catches come from eight different collecting methods:

- Kempson method: On each sampling date, 314 cm^2 samples of the litter layer, including the first centimetre of mineral soil, were taken at each forest stand. A steel cylinder (20 cm in diameter and 25 cm high), equipped with an opening device, enabled extraction of intact sample units.

Spiders were extracted by creating gradients of light, humidity and temperature using a Kempson apparatus (KEMPSON *et al.*, 1963). Kempson extraction estimates densities of spiders and soil fauna with a high degree of accuracy (EDWARDS & FLETCHER, 1971). A detailed description of the use of this method may be found in BARRAQUETA (1985).

- Berlese Funnels: Litter samples of 500 cm^3, including the first centimetre of mineral soil, were taken with a shovel. Saxycolous moss samples of the same volume were collected by hand. A plastic recipient was kept in contact with the stone wall and just under the moss sampled to prevent the individuals escaping. Since there were no stones above ground level in the Zumaia stand, 8 samples of litter were taken per sampling date (see Table II).

Each sample was put into a plastic funnel with a 6 mm wire mesh inside and covered by a fibreglass mosquito net. A 60 W bulb was placed 10 cm above each funnel and left on for 8 days. This length of time ensures effective extraction (DUFFEY, 1972; HUHTA, 1972). The specimens were collected in glass bottles filled with a solution of 70% alcohol plus some drops of glycerine inside as a preservative. More details are given in CASTRO (2004b).

This kind of extraction is one of the most effective for catching spiders (EDWARDS & FLETCHER, 1971). Berlese funnels are useful for estimating population densities and for studying microhabitat preferences (HUHTA, 1971; DUFFEY, 1972; CANARD, 1981; HÖVEMEYER & STIPPICH, 2000).

- Epigeal pitfall traps: These were made using plastic beakers 6.5 cm in diameter and 8 cm high. Another smaller beaker was placed inside to avoid turning over mud and litter around the trap. The risk of flooding by rain and clogging with litterfall was prevented by making two small holes in the upper third of the beaker, and placing a cork (evergreen oak forests) or plastic (Artikutza) roof, held by wire, 5 cm above the trap. Each trap was filled to one-third full with a solution of 4% formalin as preservative. Some drops of detergent were added to increase capture efficiency (TOPPING & LUFF, 1995). Samples were taken uninterruptedly every two weeks, except in 1996 (Artikutza) on the following dates: 18-II, 28-VII, 8-IX, 3-XI and 29-XII.

Pitfall traps are efficient for collecting a great number of species (UETZ & UNZICKER, 1976; CANARD, 1981; CHURCHILL & ARTHUR, 1999; HÖVEMEYER & STIPPICH, 2000, STANDEN, 2000; BUDDLE & HAMMOND, 2003). They mostly catch mature individuals (TOPPING & SUNDERLAND, 1992), which facilitates identification at species level of most specimens. They are also useful for studying the seasonal dynamics and mating periods of epigeal spiders, favouring the capture of cursorial species (CURTIS, 1980; BARRIENTOS, 1985a; CHURCHILL, 1993; LANG, 2000). Another advantage is that they act continuously, allowing both diurnal and nocturnal species to be caught.

- **Malaise Traps:** The model proposed by TOWNES (1972) was used: black with a white roof and thin mesh. The collecting recipient was placed at a height of 2 m and filled with a solution of 75% ethanol and 5% acetic acid (MARTÍNEZ DE MURGUÍA, 2002). Samples were taken uninterruptedly every two weeks, except in 1996 on the following dates: 18-II, 28-VII, 8-IX, 3-XI and 29-XII.

These traps are normally used to capture flying insects (PUJADE, 1996). Because they are complex to install, and collect a considerable quantity of insects, they are usually set up in small numbers or for short time periods, yielding low catches of spiders (see data in BARRIENTOS & PUJADE, 1999 and VECÍN *et al.*, 2002). However, 6 traps placed in Artikutza that were active for two years yielded a large number of spiders. The method biases towards typical dwellers of higher-than-epigeal vegetation strata (HAUGE & MIDTGAARD, 1986). The spider fauna of Malaise traps shows greater similarity with arboreal stratum than epigeal, because the method probably collects herbaceous and bush strata dwellers (JENNINGS & HILBURN, 1988).

- **Bark traps:** These traps were 20 x 30 cm in size. They were tied with wire around tree trunks at a height of 1.5 m. Two kinds of traps were laid: some made of corrugated cardboard (described in DUFFEY, 1969) and some of grooved plastic (see CASTRO, 2004b). In the evergreen oak forests, only plastic traps were used, while in Igara 20 of each type were laid.

Bark traps have been used to study species composition and seasonal dynamics of spiders on trunks (DUFFEY, 1969; CURTIS & MORTON, 1974; HORVÁTH & SZINETÁR, 1998; HORTON *et al.*, 2001).

- **Trunk pitfall traps:** These consisted of white plastic beakers 5.5 cm in diameter and 6.5 cm high. They were tied with wire around tree trunks at a height of 1.5 m. Two small holes were made in the upper third of each beaker to prevent flooding. A saturate ClNa solution was used as a preservative. Some drops of detergent were added to increase catch effectiveness (TOPPING & LUFF, 1995).

These traps are used for the same purposes as epigeal pitfall traps (RUZICKA *et al.*, 1991; WEISS, 1995; RUZICKA, 1997).

- **Beating:** This method consisted of beating one sector of vegetation 30 times with a stick. Spiders were collected on a white sheet of 1 m^2 spread out and placed 50 cm under sampled vegetation. Samples were taken between 0.5-1.5 m for liana stratum (made up *Smilax aspera* L.) and between 1.5-4 m for tree foliage (more details in CASTRO, 2004b).

Beating allows vegetation parts to be reached that are not accessible using other methods, yielding an abundant catch. However, it is important to bear in mind that the time of day, meteorological conditions and vegetation height can influence the number of individuals and species composition collected (ABRAHAM, 1983; CODDINGTON *et al.*, 1996; SORENSEN *et al.*, 2002).

- Chance searching by hand: While sampling, spiders detected visually by chance were collected by hand or with the help of a paintbrush moistened with alcohol.

This method allows valuable complementary information to be gleaned on the microhabitat and biological aspects of the species (DUFFEY, 1972; FUJII, 1998).

Site Method	Number of traps or samples	Periodicity	Number of collections per trap or sample	Whole sampling period	Forest habitats
Gorbea					
K	32-40	1 month	14	V-1982 to VI-1983	Forest litter
Artikutza					
P	30	2 weeks	46	V-1995 to V-1997	Epigeic
M	6	2 weeks	46	V-1995 to V-1997	-
Evergreen oak forests					
P	30	2 weeks	27	XII-1998 to XII-1999	Epigeic
Fl	28	8 weeks	6	I-1999 to X-1999	Forest litter
Fm	20	8 weeks	6	I-1999 to X-1999	Saxycolous moss
BT	30	4 weeks	12	I-1999 to XII-1999	Tree trunks
TP	30	2 weeks	23	I-1999 to XII-1999	Tree trunks
BL	30	8 weeks	7	XII-1998 to XI-1999	Liana layer
Bf	30	8 weeks	7	XII-1998 to XI-1999	Tree foliage
C	-	2 weeks	-	XII-1998 to XII-1999	Several
Igara					
BT	40	1 month	12	IX-2002 to VIII-2003	Tree trunks

Table II.- Summary of the sampling program carried out in each study site. Abbreviations: K: Kempson method, P: epigaeic pitfall traps, M: Malaise traps, Fl: Berlese funnels, litter samples, Fm: Berlese funnels, saxycolous moss samples, BT: bark traps, TP: trunk pitfall traps, Bl: beating of liana layer, Bf: beating of tree-foliage, C: chance hand collecting.

Identification and preservation of spiders: Species were identified using the classic European keys of ROBERTS (1985-87, 1995), HEIMER & NENTWIG (1991), NENTWIG *et al.* (2003) and SIMON (1914-1937). The nomenclature used was as proposed by PLATNICK (2008).

Several more specialized works were used to identify correctly certain individuals belonging to the following families: Agelenidae: BARRIENTOS (1985b). Anyphaenidae: URONES *et al.* (1995b). Atypidae: KRAUS & BAUR (1974) and CANARD (1983). Linyphiidae: FAGE (1919), SCHENKEL (1938), DENIS (1965), SAARISTO (1974), MILLIDGE (1975), RIBERA & HORMIGA (1985) and BOSMANS (1995). Mimetidae: CANARD (1982). Salticidae: SNAZELL *et al.* (1999). Theridiidae: VANUYTVEN (1991) and KNOFLACH (1993). Thomisidae: LOGUNOV (1992). Uloboridae: WIEHLE (1964). Zodariidae: BOSMANS (1997).

The collaboration of several taxonomists was needed to identify some more difficult specimens: Robert Bosmans from the University of Gent, Belgium (Theridiidae y Salticidae); Miguel Ángel Ferrández from the Society for the Study and Conservation of Spiders, Spain (Segestriidae, Dysderidae and several families); Peter Van Helsdingen (Linyphiidae) of the National Museum of Natural History of Holland, Eduardo Morano of the Iberian Arachnology Group, Spain (Araneidae, Tetragnathidae); Carles Ribera of the University of Barcelona, Spain (Linyphiidae); Michael Saaristo of the Museum of Zoology, Turku, Finland (Linyphiidae) and Carmen Urones of the University of Salamanca, Spain (Miturgidae).

Spiders were preserved in 70% ethanol and stored in the Entomology Department of the Sociedad de Ciencias Aranzadi (San Sebastián, Spain).

Data analysis: In order to determine which is the best period of the year to sample, seasonal variations in species richness were displayed in graph form. This determination was based in the highest occurrence of species in adult stage, although species at immature phases were also added to the analysis because there is little literature available on seasonal variations in their richness. For each species, graphical displays were limited to the most abundant species (> 10% of identified sample to the species level per study site and method).

This analysis was limited to sampling methods that were carried out systematically at least 12 times, completing an entire year. Thus data from samples from Berlese funnels, beating, and hand searching from evergreen oak forests were used as complementary data to confirm the occurrence of the species in specific periods of the year and forest strata. Data from the six evergreen oak forests were pooled, and there are therefore two values for the dates displayed, because in two stands (Ataun and Larraun) sampling started one week later than in the other four.

The occurrence periods of each species were determined by reviewing data from this study and from the main studies (101 in total) on biological cycles and seasonal dynamics of European spiders. Among them, several with scattered records were consulted to complete the scarce knowledge that exists on some little-studied spiders of South European distribution.

Most of the literature consulted was based on pitfall traps. It was therefore possible to determine the main activity periods for several species. For each study consulted, all the maximum activity periods of the most abundant species were registered. Since some species were represented in more than one study and activity patterns may vary from year to year, the period finally obtained for each species is probably wider it would be for any one specific year. Data which did not match the literature reviewed is dealt with in the discussion.

Classifications of dynamic cycles based on overwinter stages and season and length of breeding period (TRETZEL, 1954; SCHAEFER, 1977; YSNEL & CANARD, 1990) were avoided for the following reasons: 1) It was impossible to identify all immature specimens, 2) there is a lack of information in most literature on immature stages, 3) sometimes the same species is classified differently depending on the source, and 4) in the absence of direct observations, it is difficult to determine whether a long period of male activity is due to a eurychronous species with several overlapping generations or to a diplochronous species with a partial concurrence of two different generations.

RESULTS

Global results and faunistic contribution

Breakdown data of samples from Gorbea, Artikutza and Igara are shown in Appendices I, II, III and IV, respectively. Breakdown results from evergreen oak forests have been published in CASTRO (2004b), and for this reason are not given here.

All samples together added up to 6976 specimens collected (inmatures included). 5407 spiders (77.51%) could be identified to species level. The various sampling methods accounted for the following percentages of identified individuals: Pitfall traps: 98.44% in Artikutza and 93.74% in evergreen oak forests; Kempson method: 45.51%; Berlese funnels: 82.29%; Trunk pitfall traps: 71.49%; Bark traps: 90.88% in evergreen oak forests and 91.76% in Igara; Beating: 70.61%; Hand searching: 84.38%.

Table III shows how the higher the forest stratum sampled, the smaller the proportion of adult specimens present, both in abundance and activity. Rates of adults and immature specimens matched for different sites and years in methods that register abundances in the same kind of microhabitat (Litter: Kempson and Berlese. Tree trunks: bark traps).

Sampling method (Site)	Males	Females	Juveniles
Activity			
P (Artikutza)	73.68	15.38	10.94
P (Evergreen oak forests)	52.95	22.79	24.25
M (Artikutza)	37.40	14.48	48.12
TP (Evergreen oak forests)	18.88	15.26	65.86
Abundance			
K (Gorbea)	6.18	15.75	78.07
Fl (Evergreen oak forests)	7.41	13.33	79.26
Fm (Evergreen oak forests)	4.06	10.43	85.51
BT (Evergreen oak forests)	1.66	13.81	84.53
BT (Igara)	2.69	12.94	84.37
Bl (Evergreen oak forests)	2.75	6.42	90.83
Bf (Evergreen oak forests)	2.35	7.40	90.25

Table III.- Percentage of mature and immature specimens caught using each sampling method. Abbreviations: see Table II.

Identified specimens have yielded 148 species distributed in 27 families (Table IV). Three species, *Centromerita bicolor*, *Micrargus apertus* and *Midia midas* were new records for Iberian fauna, while *Peponocranium ludicrum* was a new genus record for Spain. According to PLATNICK (2008), known geographic distributions for these four species are Palaearctic and Canada, Palaearctic, Europe, and Europe and Russia, respectively.

Two species *Centromerus* sp. and *Tenuiphantes* cf. *jacksoni*, are currently being reviewed by specialists. *Tenuiphantes* cf. *jacksoni* could be a new species for science (VAN HELSDINGEN, BOSMANS, personal communication).

Following MELIC (2001) – excepting where other authors are indicated – 8 species were endemisms of Ibero-Pyrenean scope or surrounding distributions: *Troglohyphantes furcifer* is found in the Spanish autonomous regions of the Basque Country, La Rioja and Navarra and in the French *department* of Basses Pyrénées. *Bordea negrei* is a Pyrenean endemism. *Labulla flahaulti* is found in Southern France and the Pyrenees (HORMIGA & SCHARFF, 2005). *Tegenaria inermis*, *Chorizomma subterraneum*, *Walckenaeria dalmasi*, and *Malthonica lusitanica* are Pyrenean and Northern Iberian Peninsula endemisms, the distribution of the latter extending to almost the entire Atlantic area of the peninsula (BARRIENTOS & CARDOSO, 2007), while *Lepthyphantes bacelarae* is an Iberian-Atlantic endemism (CASTRO & ALBERDI, 2002).

Another six species showed a known South-western European distribution: *Dysdera fuscipes* from the Atlantic seacoast of Northern Portugal and Spain and the southern half of France (FERRÁNDEZ, 1985b; LE PERU, 2007). *Palliduphantes cernuus* from the Pyrenees and Corsica (RIBERA & HORMIGA, 1985). *Episinus theridioides* from the Pyrenees, Corsica and Sardinia (BOSMANS & CASTRO, 2002). *Anyphaena numida* from the French *department* of Pyrénées Orientales, the northern half of the Iberian Peninsula and Algeria (URONES, 1996). *Nemesia simoni* from Portugal, Spain and Southern France, and *Entelecara aestiva* from Spain, France, Corsica and Italy (LE PERU, 2007; PLATNICK, 2008).

Seasonal dynamic of species richness: Among most species, activity was concentrated from spring to autumn (Figures 1 and 2). A winter minimum was usually found in January-February. Activity peaked in spring (normally in May-June) and autumn (varying between September and November). Some relative minima and maxima were observed between these two peaks. Autumn maxima showed more species at immature stages than spring peaks. The largest proportion of immature spider species was found from late summer, continuing right through the autumn. Spring peaks were almost exclusively made up of species at adult stage. Peaks in Artikutza obtained in pitfall traps were smaller in the second year than in the first year (Figure 1). This trend was not observed in samples from Malaise traps.

Epigeal pitfall and Malaise traps showed continuous activity of adults all year round, except for some sporadic interruptions in winter in Artikutza. In contrast, activity halted all winter in trunks of trees in evergreen oak forests.

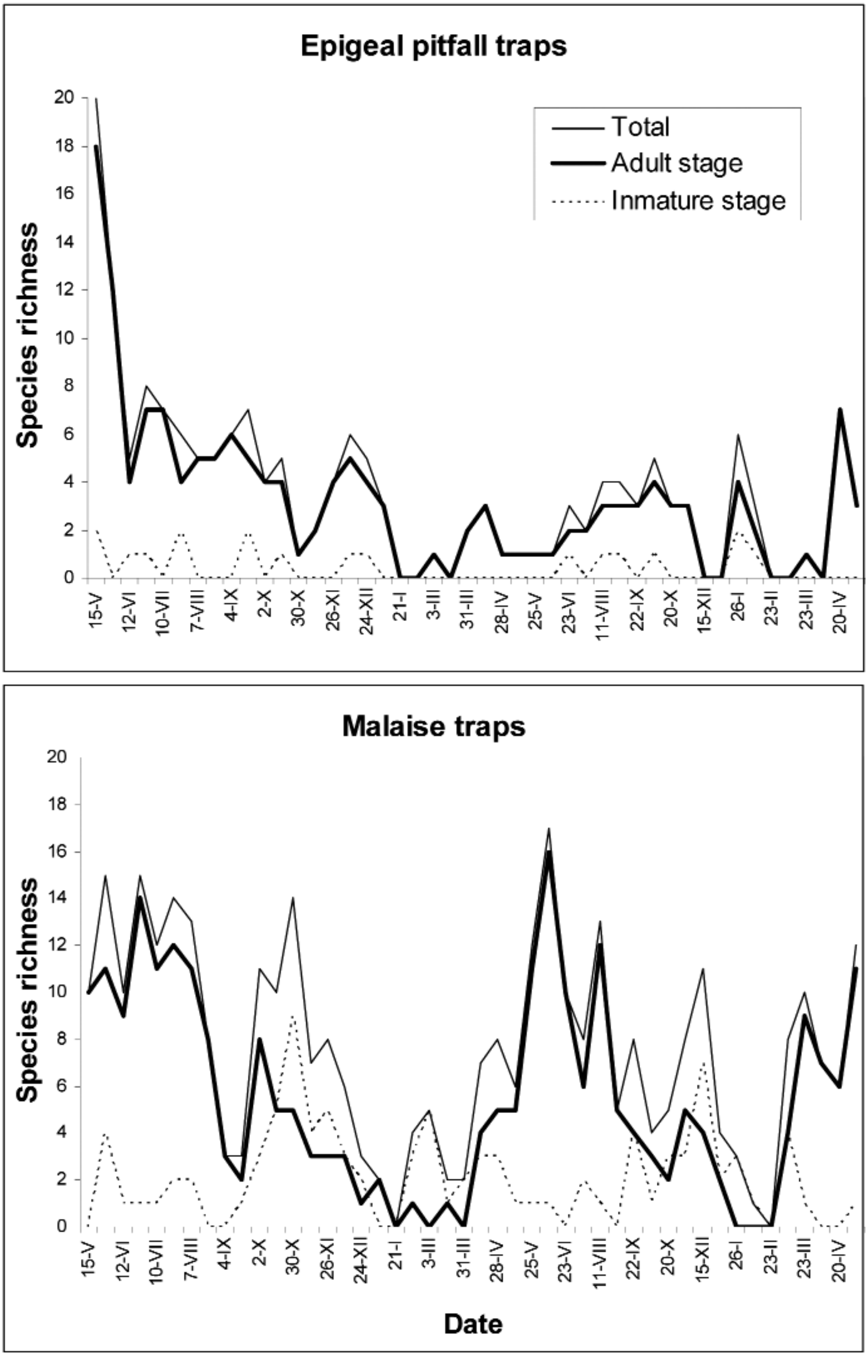
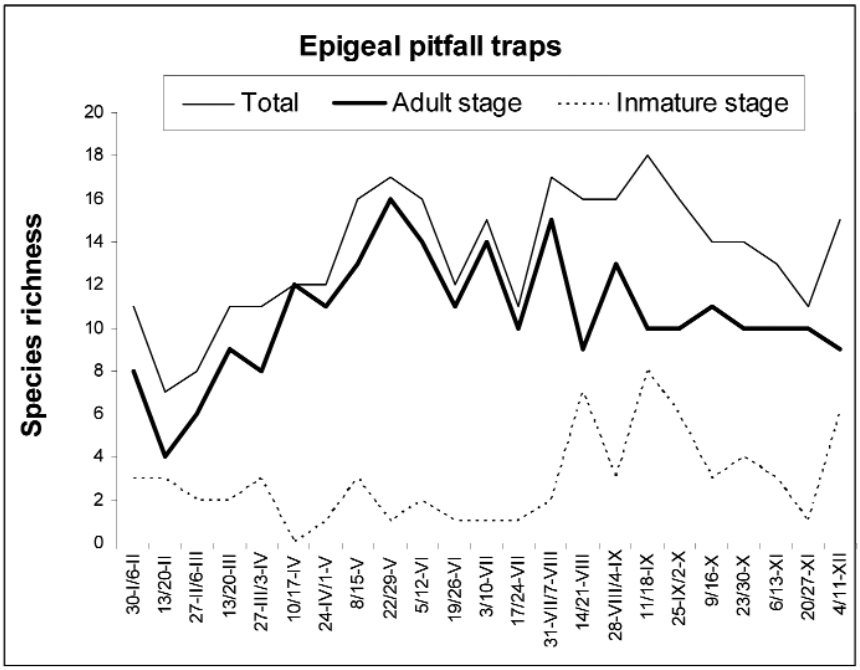


Figure 1.- Seasonal changes in species richness recorded in the beech forest of Artikutza.



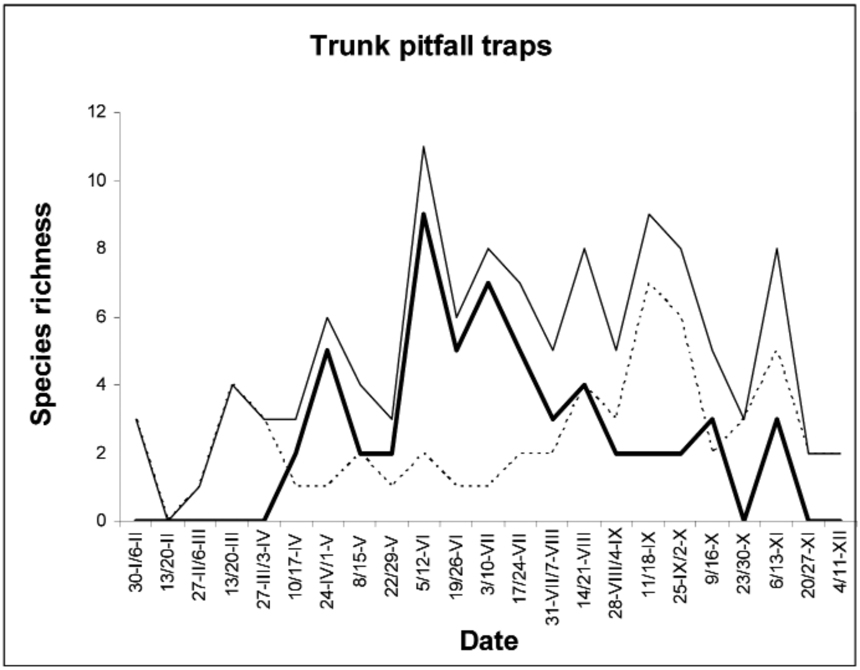


Figure 2.- Seasonal changes in species richness recorded in Cantabrian evergreen oak forests.

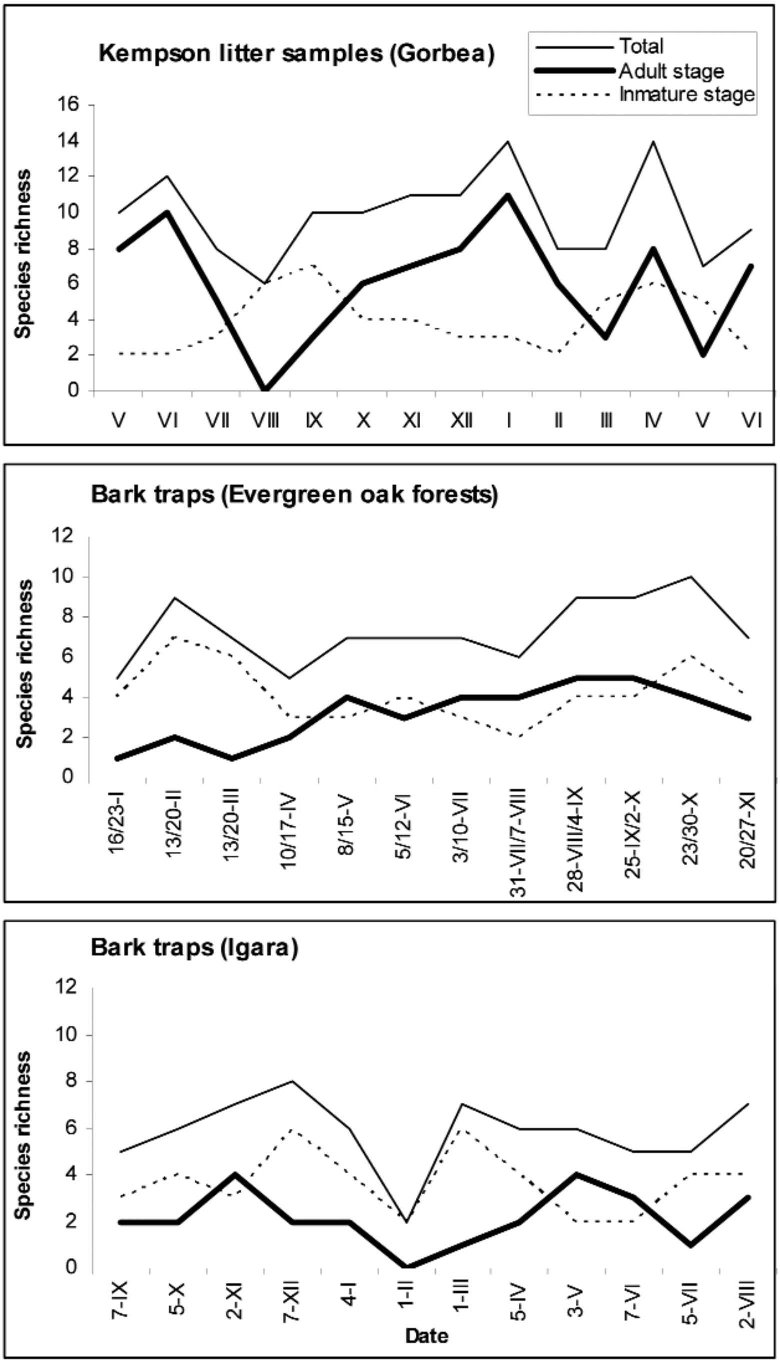


Figure 3.- Seasonal changes in species richness recorded in the litter layer and in barks.

Nonetheless, adult-stage species were present all year round in the litter and tree bark (Figure 3). In these samples, the largest proportion of species in adult stage also occurred in spring (and in a part of the summer in the evergreen oak forests). The minima occurred in winter in the bark traps and in summer in Kempson samples. Overall species richness in bark traps attained a maximum in autumn, continuing in winter, but interrupted by a relative minimum in January or in February. In litter samples from Gorbea, overall species richness peaked in January, showing another relative maximum in April, after a relative minimum in February-March.

If we continue to focus on adult stages, Table IV shows periods of maximum activity and presence for each species. It has been possible to determine the period of maximum activity of males, females, or both for 119 species. May and June were the months most frequently included in the periods of maximum breeding activity (Figure 4). Together these months encompassed 78.15% of species. If the entire period of adult presence – currently known – is taken in account, besides breeding peaks, 93.92% of the 148 species found were included between May and June.

Sampling data coincided with this trend: May and June usually continue to be the months with the highest number of species (Table V). Kempson samples from Gorbea and bark traps from the evergreen oak forests were the exceptions to this pattern. However, pooled together, May and June ranked as the second richest

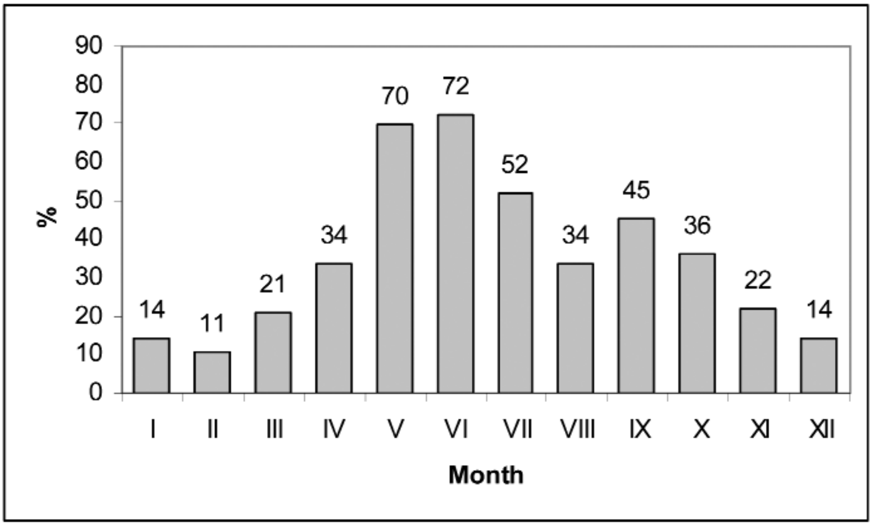


Figure 4. Percentage of mature species that include the specified month in their main reproduction period.

TAXA	Presence of males	Presence of females	Reference number
AGELENIDAE			
Malthonica lusitanica Simon, 1898	V-XII (I-XII)	VI-XI (I-XII)	14,15,17
Malthonica picta (Simon, 1870)	V-VI, IX (II-IX)	VII-VIII (IV-X, XII)	15,35,98,99,111
Tegenaria fuesslini Pavesi, 1873	VI-VII , IX (III-XI)	III-VII (I-XI)	15,111
Tegenaria inermis Simon, 1870	(I-XII)	(I-XII)	55,59,60,61,127, 173
Textrix denticulata (Olivier, 1789)	V-VII (V-IX)	V-IX (I-XII)	15,78
AMAUROBIIDAE			
Amaurobius feroz (Walckenaer, 1830)	III-V (I-XI)	IV-VII (I-XII)	78
Amaurobius similis (Blackwall, 1861)	IX-XI (I-XII)	IX-VI (I-XII)	78,111
Coelotes terrestris (Wider, 1834)	VIII-XI (I-XII)	V (I-XII)	4,9,10,78,160,164,171,172, 189
ANYPHAENIDAE			
Anyphaena accentuata (Walckenaer, 1802)	V-VI (XII-VIII)	V-VI (I-XII)	78,111,164,182,200
Anyphaena numida Simon, 1896	IX (VII-IX)	XI (I-XII)	200
ARANEIDAE			
Araneus diadematus Clerck, 1757	VIII-IX (III, VI-X)	VIII-X (IV-II)	78,100,164,182,214
Araniella cucurbitina (Clerck, 1757)	V-VI (IV-IX)	VI (IV-IX)	19,78,100,111,138,164,182, 214
Cyclosa conica (Pallas, 1772)	V-VI (IV-VII)	V-VI (III-IX, XI)	78,111,138,164,182,214
Mangora acalypha (Walckenaer, 1802)	V-VI (IV-IX)	VI (V-IX)	19,78,111,164,214
Nuctenea umbratica (Clerck, 1757)	VI-X (IV-I)	IV-X (I-XII)	78,100,138,164,214
Zilla diodia (Walckenaer, 1802)	V-VI (IV-VI, X)	V-VI (IV-X)	78,111,214
ATYPIDAE			
Atypus affinis Eichwald, 1830	IX-X (VIII-I, IV-VI)	(I-XII)	35,78,108,111,129
CLUBIONIDAE			
Clubiona brevipes Blackwall, 1841	V-VI (IV-I)	VI-VII (I-XII)	63,78,111,182
Clubiona caerulescens L. Koch, 1867	(IV-IX)	(V-IX)	111,133,147
Clubiona comta C. L. Koch, 1839	III-VI (III-VII, IX)	V-VII (I-XII)	10,78,147,164,182,183,195
Clubiona pallidula (Clerck, 1757)	V-VI (IV-VII, IX, XI)	V-VI (II, IV-X, XII)	78,164,182,183
Clubiona terrestris Westring, 1851	V-X (I-XII)	V-VII, IX-X (I-XII)	78,99,100,164,182, 183,195
DICTYNIDAE			
Chorizomma subterraneum Simon, 1872	VIII-I (VIII-VI)	I, IV, IX (I-XII)	15
Nigma puella (Simon, 1870)	VI (IV-VII)	VI (IV-IX)	78,111
Nigma walckenaeri (Roewer, 1951)	IX-X (VIII-I)	IX-X (VII-XI, I)	78,147

Table IV.- Months of the highest activity and presence (in brackets) of each species.

TAXA	Presence of males	Presence of females	Reference number
DYSDERIDAE			
Dysdera fuscipes Simon, 1882	(III-VIII)	(IV, VI-VII, IX)	70,71,159
Harpactea hombergi (Scopoli, 1763)	V, IX (I-XII)	V, IX (I-XII)	18,78,182
GNAPHOSIDAE			
Drassodes cupreus (Blackwall, 1834)	V-VII (III-IX)	VI-VIII (II, IV-XII)	78,129
Zelotes aeneus (Simon, 1878)	IX (VII-X)	(VII-XII)	98,111,201
Zelotes apricorum (L. Koch, 1876)	VI, IX (IV-X)	VI (III-XI)	78
Zelotes latreillei (Simon, 1878)	IV-VI, VIII-IX (III-XI)	V-VI (II, IV-XI)	9,78,100,111,129,164,188
Zelotes subterraneus (C. L. Koch, 1833)	IV-VI (IV-X)	IV-VI, VIII-X (IV-X)	2,29,78,100,164,188
HAHNIIDAE			
Hahnia helveola Simon, 1875	X-II (VI-IV)	IX-XI, IV-VI (IX-VI)	78,111,128,160
Hahnia montana (Blackwall, 1841)	VIII-X (VI-I, IV)	III-VI, X-XI (I-XII)	35,78
Hahnia nava (Blackwall, 1841)	IV-VI, X (II-XII)	IV-VI (III-X)	15,35,62,78,128,164
LINYPHIIDAE			
Bordea negrei Dresco, 1951	(II, VI, XII)	(II, VI-X)	24,111
Centromerita bicolor (Blackwall, 1833)	X-II (VIII-IV)	IX-III (I-XII)	10,78,82,140,164,188
Centromerita concinna (Thorell, 1875)	IX-I (IX-VII)	III-V, XI (I-XII)	78,79,129,140,164
Centromerus sp.	-	(VII-VIII)	-
Centromerus albidus Simon, 1929	XI (IX-III, V-VII)	(X-VI)	19,111
Centromerus dilutus (O. P. – Cambridge, 1875)	X-III (I-XII)	II-VI (I-XII)	10,50,74,78,129,152,164
Centromerus sylvaticus (Blackwall, 1841)	X-I (VII-V)	X-XI (I-XII)	2,9,10,29,30,50,78,99,109,140,152,160,164,182,188
Ceratinella brevis (Wider, 1834)	IV-VII, IX-X (I-XII)	IV-X (I-XII)	29,78,141,164,188
Cnephalocotes obscurus (Blackwall, 1834)	III-VII (I-XII)	IV-IX (I-XII)	9,62,78,141
Diplocephalus latifrons (O. P. – Cambridge, 1863)	III-VII, IX-X (I-XII)	V-VII (I-XII)	4,9,78,79,129,141,164,182,188
Diplocephalus picinus (Blackwall, 1841)	IV-VII (I-XII)	V-VII (I-XII)	10,29,45,50,78,99,129,141,164,182
Drapetisca socialis (Sundevall, 1833)	VIII-X (VII-I, III)	VII-XI (I, III, VI-XII)	3,78,140,164,182
Entelecara aestiva Simon, 1918	(V-VI)	(VI-VII)	54,56,146,175
Entelecara congenera (O. P.-Cambridge, 1879)	V-VI (V-VI)	V-VI (III, V-IX, XI-XII)	78
Erigone dentipalpis (Wider, 1834)	I-II, IV-VIII (I-XII)	VI-VII (I-XII)	10,62,78,82,129,141,164,188
Floronia bucculenta (Clerck, 1757)	VIII-X (VII-X)	VIII-X (VI-XII)	78,111,164
Gongylidiellum murcidum Simon, 1884	I (I-XII)	I (I-XII)	137,141

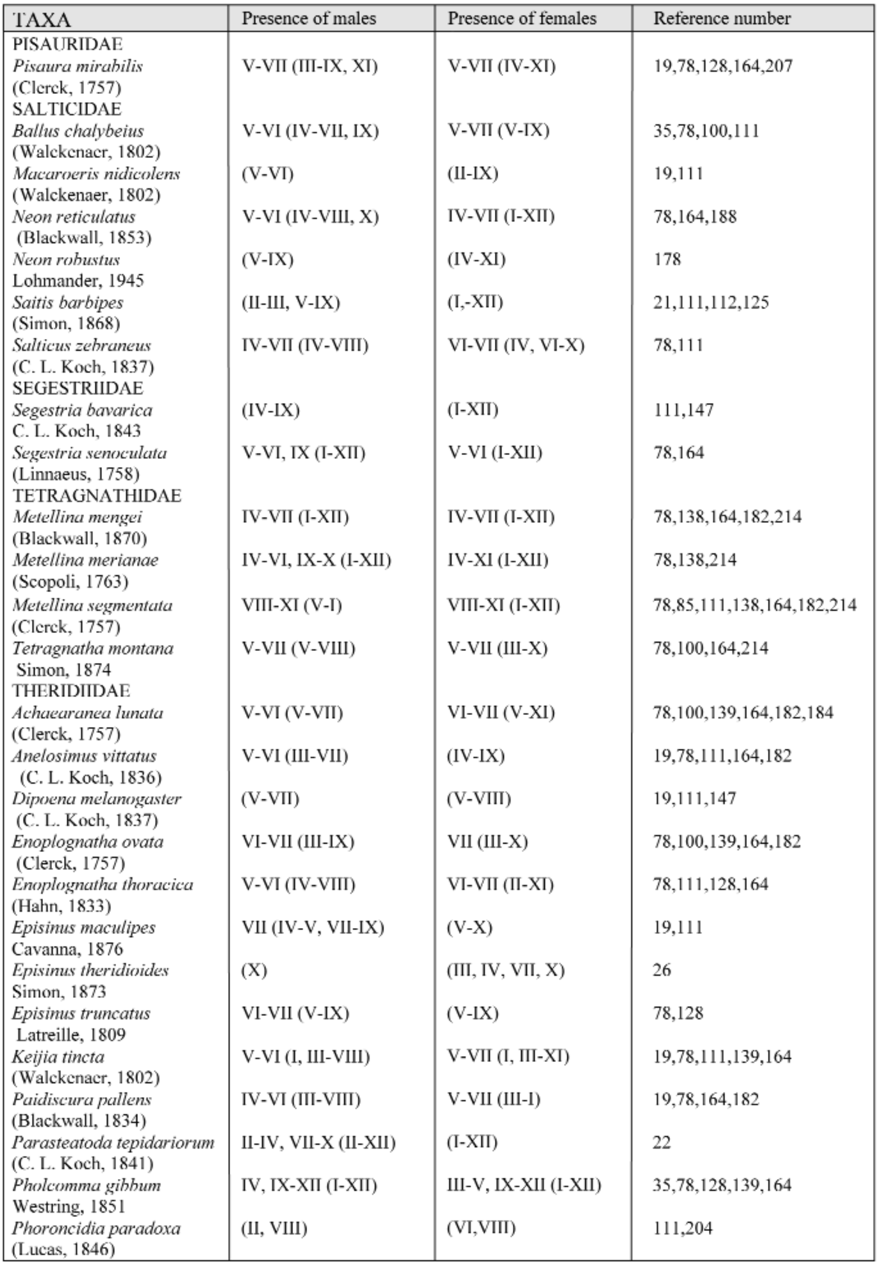
Table IV.- Continue

TAXA	Presence of males	Presence of females	Reference number
Labulla flahaulti Simon, 1914	IX (VII-X)	IX-X (VIII-XII)	-
Lepthyphantes bacelarae Schenkel, 1938	(VII)	(VII)	-
Linyphia triangularis (Clerck, 1757)	VIII-IX (V-X)	VIII-X (I, IV, VI-XII)	78,85,100,111,129, 141,164,182
Maso sundevalli (Westring, 1851)	V-VII (II-XI)	VI-VII (I-XII)	6,29,78,129,141, 164,188
Meioneta mollis (O. P. – Cambridge, 1871)	(II-IV, VII-XII)	(I-XII)	35,62,147
Meioneta rurestris (C. L. Koch, 1836)	III-IV, VI-VIII (I-XII)	VI-IX (I-XII)	5,62,78,82,129,152, 164
Micrargus apertus (O. P.- Cambridge, 1871)	IV-VI (IV-VI, IX, XI-II)	IV-VI (XII-IX)	78
Micrargus laudatus (O. P. – Cambridge, 1881)	VI (II, V-VI)	(II-III, VI-VII, IX)	129
Microneta viaria (Blackwall, 1841)	III-VII, X-XI (I-XII)	II-VII, X-XI (I-XII)	30,45,74,78,99,129,140, 152,160,164,182,188
Midia midas (Simon, 1884)	(V-VIII)	(V-IX)	78
Minyriolus pusillus (Wider, 1834)	VI-IX (I-XII)	X (I-XII)	9,29,78,79,91,92,141, 164,188
Monocephalus castaneipes (Simon, 1884)	I (I-V, IX-XI)	IV-V (I-II, IV-V, VII-XI)	78,111
Monocephalus fuscipes (Blackwall, 1836)	X-I, III-V (I-XII)	III-VII, X (I-XII)	10,50,74,78,99,129
Palliduphantes cernuus Simon, 1884	XII-III, V-VII (I-XII)	VI-VII (II-XII)	152
Parapelecopsis nemoralis (Blackwall, 1841)	X-I (VIII-III, VI)	(I-XII)	23,111
Peponocranium ludicrum (O. P. – Cambridge, 1861)	IV-VII (II-VIII)	V-VII (I, III-XI)	35,78,111,129
Pocadicnemis juncea Locket & Millidge, 1953	V-VII (I-XII)	V-VII (IV-X)	5,78
Pocadicnemis pumila (Blackwall, 1841)	V-VII (I, II-XI)	V-IX (I-XII)	9,10,29,78,82,111, 141,164,188
Saaristoa abnormis (Blackwall, 1841)	VI-IX (II-XII)	VI-VII (I-XII)	29,45,78,111,164
Tapinocyba mitis (O. P.-Cambridge, 1882)	II-III (IX-V)	(X-III, V, VII-VIII)	35,111,129
Tapinopa longidens (Wider, 1834)	VIII-X (I, VI-XI)	VII-X (VI-IV)	4,78,111,129,140,164
Tenuiphantes cf. *jacksoni*	V-VII (IV-IX, XI)	(I, IV-VIII, X-XI)	-
Tenuiphantes cristatus (Menge, 1866)	X-IV (VII-VI)	III-VI, IX-XI (I-XII)	29,78,79,111,164,182
Tenuiphantes flavipes (Blackwall, 1854)	IV-VII, IX-XII (I-XII)	III-VII, IX-XI (I-XII)	10,78,99,129,152,164, 182
Tenuiphantes mengei Kulczynski, 1887	V-VIII, XI (I-XII)	IV-IX, XI (I-XII)	2,9,10,29,78,129,164, 188
Tenuiphantes tenuis (Blackwall, 1852)	VI-XI (I-XII)	VI-XI (I-XII)	10,62,78,82,129, 152,164
Tenuiphantes zimmermanni Bertkau, 1890	V-XII (I-XII)	VI-XI (I-XII)	4,9,45,50,78,99,129, 152,164,182
Theonina cornix Simon, 1881	(IV-VII, XI-II)	(I-II, IV-VII, IX)	111,113,167

Table IV.- Continue

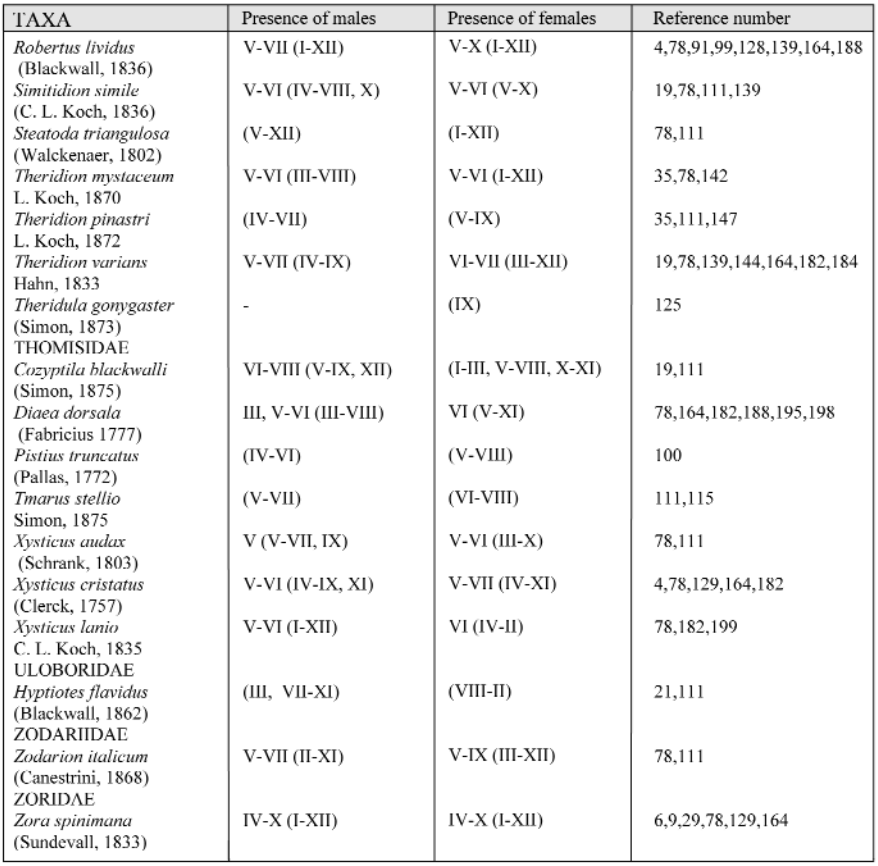
TAXA	Presence of males	Presence of females	Reference number
Trichoncus affinis Kulczynski, 1894	V-VI (V-VI, VIII-IX)	VI-IX (I, IV-IX)	78
Troglohyphantes furcifer (Simon, 1884)	VII (III, VI-IX)	(III-IV, VI-IX)	69,173
Walckenaeria acuminata Blackwall, 1833	IX-IV (I-XII)	III-XI (I-XII)	9,29,50,78,129,141,160, 164,188
Walckenaeria corniculans (O. P.-Cambridge, 1875)	V-VI (I-XII)	(I-XII)	4,10,164
Walckenaeria cucullata (C. L. Koch, 1836)	III-IV, X (I-XII)	III-VIII (I-XII)	10,29,78,129,141,164, 182,188
Walckenaeria dalmasi Simon, 1914	(IV-V, XI)	(III, V, XI)	113
Walckenaeria furcillata (Menge, 1869)	V-VII (V-VII)	VI-VIII (V-IX)	78,160,164
LIOCRANIDAE			
Agroeca inopina O. P.-Cambridge, 1886	IX-XI (IX-II)	IX-XI (IX-VII)	78,129,195
Liocranum rupicola (Walckenaer, 1830)	(III-VIII)	(II-XII)	76,111,147
Scotina celans (Blackwall, 1841)	XII-III (IX-IV)	XII-III (I-XII)	19,35,78,129,195
LYCOSIDAE			
Aulonia albimana (Walckenaer, 1805)	V-VI (V-VIII, X)	V-VII (IV-X, XII)	10,16,111,188
Pardosa lugubris (Walckenaer, 1802)	V-VII (III-VIII)	V-VII (III-X)	16,29,66,96,128,160, 164,182
Pardosa nigriceps (Thorell, 1856)	V-VII (IV-VIII)	V-VII (IV-XI)	6,9,16,78,128,164, 188,205,207
Pardosa pullata (Clerck, 1757)	IV-VIII (I-XII)	V-VIII (IV-XI)	5,7,9,62,78,79,84,96,136 153,164188,205,207
Trochosa terricola Thorell, 1856	III-VI, IX-X (II-XI)	IV-IX (I-XII)	2,6,9,10,16,29,78,79,96, 128,164,182,188,210
MIMETIDAE			
Ero aphana (Walckenaer, 1802)	(I, IV-VII)	(II-X)	35,72,111
Ero furcata (Villers, 1789)	VIII-XI (I-XII)	VIII-XI (I-XII)	6,35,78,128,138,164,182
MITURGIDAE			
Cheiracanthium mildei L. Koch, 1864	(V-VII)	(I-II, V-VI, VIII-XI)	111,119
NEMESIIDAE			
Nemesia simoni O. P.-Cambridge, 1874	IX-XI (IX-II)	(I-XII)	111,181
OONOPIDAE			
Oonops pulcher Templeton, 1835	IV-V, IX (I-XII)	III-VI, VIII-IX (I-XII)	78
Tapinesthis inermis (Simon, 1882)	-	(IX)	
PHILODROMIDAE			
Philodromus aureolus (Clerck, 1757)	V-VII (IV-IX)	VI-VII (V-X)	6,78,100,164,188
Philodromus buxi Simon, 1884	(III, V-VII)	(III, V-IX)	75,111,196
Philodromus dispar Walckenaer, 1826	V-VI (II-VII, IX, XII)	V-VI (I-XII)	78,111,196
Philodromus rufus Walckenaer, 1826	III-V (I-VIII)	(I-X)	35,100,164,196

Table IV.- Continue



TAXA	Presence of males	Presence of females	Reference number
PISAURIDAE			
Pisaura mirabilis (Clerck, 1757)	V-VII (III-IX, XI)	V-VII (IV-XI)	19,78,128,164,207
SALTICIDAE			
Ballus chalybeius (Walckenaer, 1802)	V-VI (IV-VII, IX)	V-VII (V-IX)	35,78,100,111
Macaroeris nidicolens (Walckenaer, 1802)	(V-VI)	(II-IX)	19,111
Neon reticulatus (Blackwall, 1853)	V-VI (IV-VIII, X)	IV-VII (I-XII)	78,164,188
Neon robustus Lohmander, 1945	(V-IX)	(IV-XI)	178
Saitis barbipes (Simon, 1868)	(II-III, V-IX)	(I,-XII)	21,111,112,125
Salticus zebraneus (C. L. Koch, 1837)	IV-VII (IV-VIII)	VI-VII (IV, VI-X)	78,111
SEGESTRIIDAE			
Segestria bavarica C. L. Koch, 1843	(IV-IX)	(I-XII)	111,147
Segestria senoculata (Linnaeus, 1758)	V-VI, IX (I-XII)	V-VI (I-XII)	78,164
TETRAGNATHIDAE			
Metellina mengei (Blackwall, 1870)	IV-VII (I-XII)	IV-VII (I-XII)	78,138,164,182,214
Metellina merianae (Scopoli, 1763)	IV-VI, IX-X (I-XII)	IV-XI (I-XII)	78,138,214
Metellina segmentata (Clerck, 1757)	VIII-XI (V-I)	VIII-XI (I-XII)	78,85,111,138,164,182,214
Tetragnatha montana Simon, 1874	V-VII (V-VIII)	V-VII (III-X)	78,100,164,214
THERIDIIDAE			
Achaearanea lunata (Clerck, 1757)	V-VI (V-VII)	VI-VII (V-XI)	78,100,139,164,182,184
Anelosimus vittatus (C. L. Koch, 1836)	V-VI (III-VII)	(IV-IX)	19,78,111,164,182
Dipoena melanogaster (C. L. Koch, 1837)	(V-VII)	(V-VIII)	19,111,147
Enoplognatha ovata (Clerck, 1757)	VI-VII (III-IX)	VII (III-X)	78,100,139,164,182
Enoplognatha thoracica (Hahn, 1833)	V-VI (IV-VIII)	VI-VII (II-XI)	78,111,128,164
Episinus maculipes Cavanna, 1876	VII (IV-V, VII-IX)	(V-X)	19,111
Episinus theridioides Simon, 1873	(X)	(III, IV, VII, X)	26
Episinus truncatus Latreille, 1809	VI-VII (V-IX)	(V-IX)	78,128
Keijia tincta (Walckenaer, 1802)	V-VI (I, III-VIII)	V-VII (I, III-XI)	19,78,111,139,164
Paidiscura pallens (Blackwall, 1834)	IV-VI (III-VIII)	V-VII (III-I)	19,78,164,182
Parasteatoda tepidariorum (C. L. Koch, 1841)	II-IV, VII-X (II-XII)	(I-XII)	22
Pholcomma gibbum Westring, 1851	IV, IX-XII (I-XII)	III-V, IX-XII (I-XII)	35,78,128,139,164
Phoroncidia paradoxa (Lucas, 1846)	(II, VIII)	(VI,VIII)	111,204

Table IV.- Continue



TAXA	Presence of males	Presence of females	Reference number
Robertus lividus (Blackwall, 1836)	V-VII (I-XII)	V-X (I-XII)	4,78,91,99,128,139,164,188
Simitidion simile (C. L. Koch, 1836)	V-VI (IV-VIII, X)	V-VI (V-X)	19,78,111,139
Steatoda triangulosa (Walckenaer, 1802)	(V-XII)	(I-XII)	78,111
Theridion mystaceum L. Koch, 1870	V-VI (III-VIII)	V-VI (I-XII)	35,78,142
Theridion pinastri L. Koch, 1872	(IV-VII)	(V-IX)	35,111,147
Theridion varians Hahn, 1833	V-VII (IV-IX)	VI-VII (III-XII)	19,78,139,144,164,182,184
Theridula gonygaster (Simon, 1873)	-	(IX)	125
THOMISIDAE			
Cozyptila blackwalli (Simon, 1875)	VI-VIII (V-IX, XII)	(I-III, V-VIII, X-XI)	19,111
Diaea dorsala (Fabricius 1777)	III, V-VI (III-VIII)	VI (V-XI)	78,164,182,188,195,198
Pistius truncatus (Pallas, 1772)	(IV-VI)	(V-VIII)	100
Tmarus stellio Simon, 1875	(V-VII)	(VI-VIII)	111,115
Xysticus audax (Schrank, 1803)	V (V-VII, IX)	V-VI (III-X)	78,111
Xysticus cristatus (Clerck, 1757)	V-VI (IV-IX, XI)	V-VII (IV-XI)	4,78,129,164,182
Xysticus lanio C. L. Koch, 1835	V-VI (I-XII)	VI (IV-II)	78,182,199
ULOBORIDAE			
Hyptiotes flavidus (Blackwall, 1862)	(III, VII-XI)	(VIII-II)	21,111
ZODARIIDAE			
Zodarion italicum (Canestrini, 1868)	V-VII (II-XI)	V-IX (III-XII)	78,111
ZORIDAE			
Zora spinimana (Sundevall, 1833)	IV-X (I-XII)	IV-X (I-XII)	6,9,29,78,129,164

Table IV.- Continue

period in Gorbea (13 species), and June-July in the oak forests (6 species). Besides, the lower the stratum, the sooner the species richness peak occurred: mainly in May in epigeal pitfall traps, June in Malaise and trunk pitfall traps, and the second half of June and beginning of July in trees (trunk pitfall and bark traps pooled).

Seasonal dynamics of the species: Seasonal dynamics of the most abundant species are displayed as graphs in Figures 5-9. Species whose seasonal dynamics are poorly known or for which scarce literature data are available, are shown in Figures 5 and 6. Better known species are represented in figures 7-9.

For some species, males were active for a long period (Figure 5): Adults of *Malthonica lusitanica* show oscillations in activity, though this occurred mainly in spring and autumn, with a peak of males in the autumn. *Palliduphantes cernuus* was active all year, except for late fall and the beginning of the winter, reaching the maximum in spring and early summer. Adults and immature specimens of *Chorizomma subterraneum* were present all year round. Adults were active mainly in autumn and winter, though with several fluctuations. Juveniles are most active from mid-summer to the beginning of the autumn, with three peaks of abundance in late spring, the first half of the autumn and winter (the maximum). Maximum adult abundance of *Gongylidiellum murcidum* occurred in late autumn and the beginning of the winter. Although males could be found for all autumn and winter, this period did not perhaps indicate true mating activity (this issue is dealt with later in the discussion). Other species with long activity periods in males (see Figure 7 and Appendices II and III) were *Tenuiphantes flavipes* (spring to autumn), *Tenuiphantes zimmermanni* (spring and summer) and *Tenuiphantes* cf. *jacksoni* (spring and summer).

Other species showed male activity periods restricted to a certain time of year (Figure 6): In *Dipoena melanogaster* this was from late spring to the beginning of summer. *Labulla flahaulti* adults were present from the second half of the summer to mid-autumn, while immatures appear in spring and summer. *Nemesia simoni* males reached maximum activity in autumn, mainly between September and November, with a few sporadic adult catches during the rest of the year. Males of better-known species (Figure 7 and Appendices II-IV) were active in the following periods: *Clubiona comta*, *Anyphaena accentuata* and *Pardosa lugubris* in spring, *Malthonica picta* in spring and the beginning of summer, *Textrix denticulata* and *Clubiona terrestris* in late spring and summer, *Coelotes terrestris* from mid-summer to mid-autumn and *Scotina celans* in late autumn and winter.

There were species in which both adult males and females, were present in two different periods of the year: *Episinus maculipes* at the beginning of spring and in summer (Figure 5), and *Micrargus apertus* (Figure 6) in spring and late autumn-winter.

Bark traps showed the seasonal dynamics of immatures of several species, whose captures were concentrated from late summer to winter (Figure 8). Despite the activity overlap among the species, their peaks did not coincide, with the exception of *Clubiona brevipes* and *Cheiracanthium mildei*. However, both species co-occurred in the forest of Zumaia, where the dates of their peaks also differ (CASTRO, 2004b).

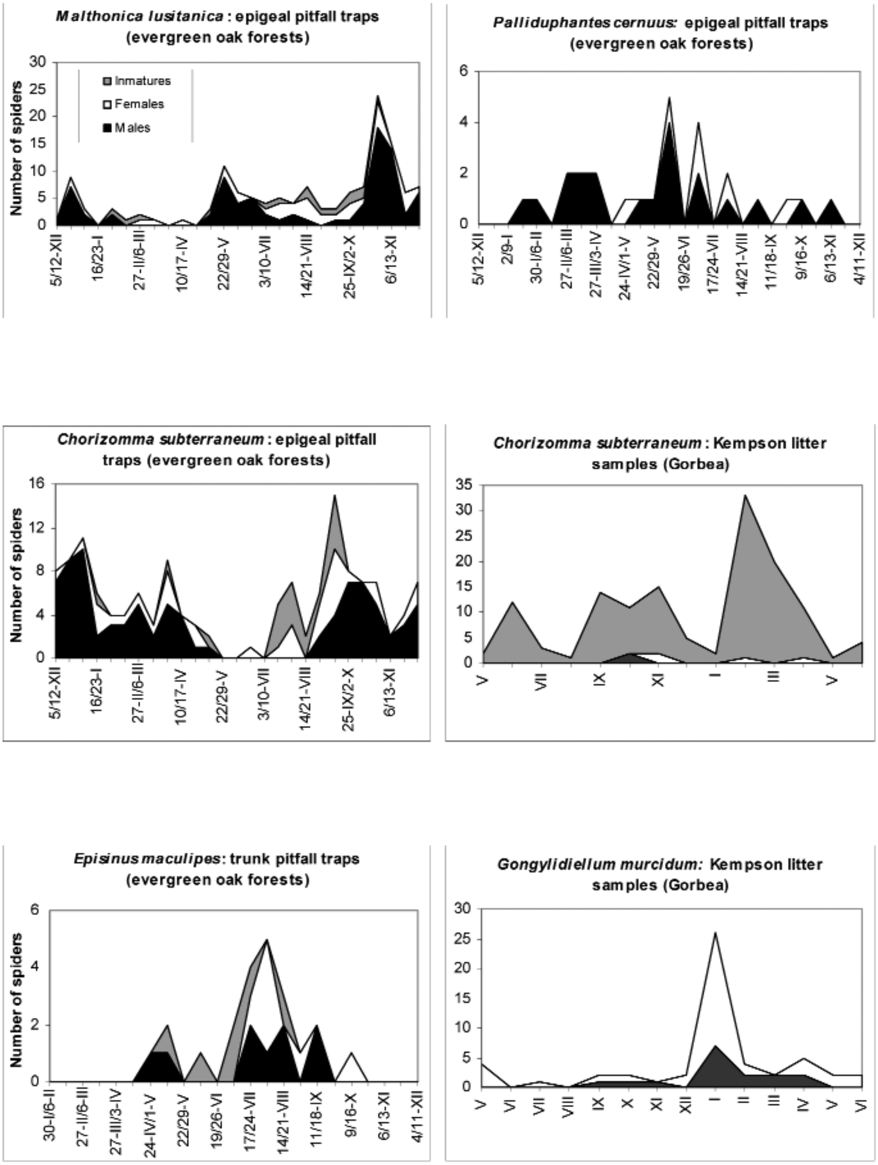


Figure 5.- Seasonal dynamics of species with scarce bibliographical data.

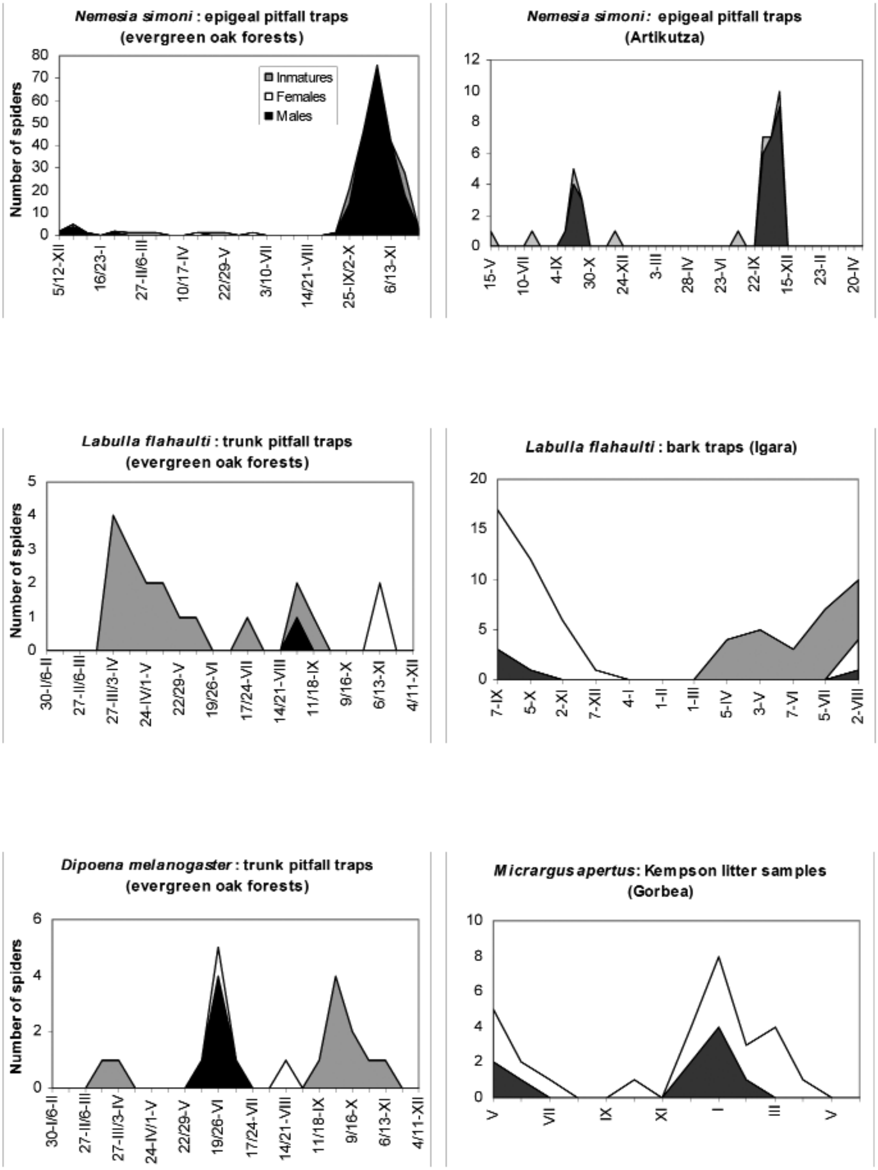


Figure 6.- Seasonal dynamics of species with scarce bibliographical data.

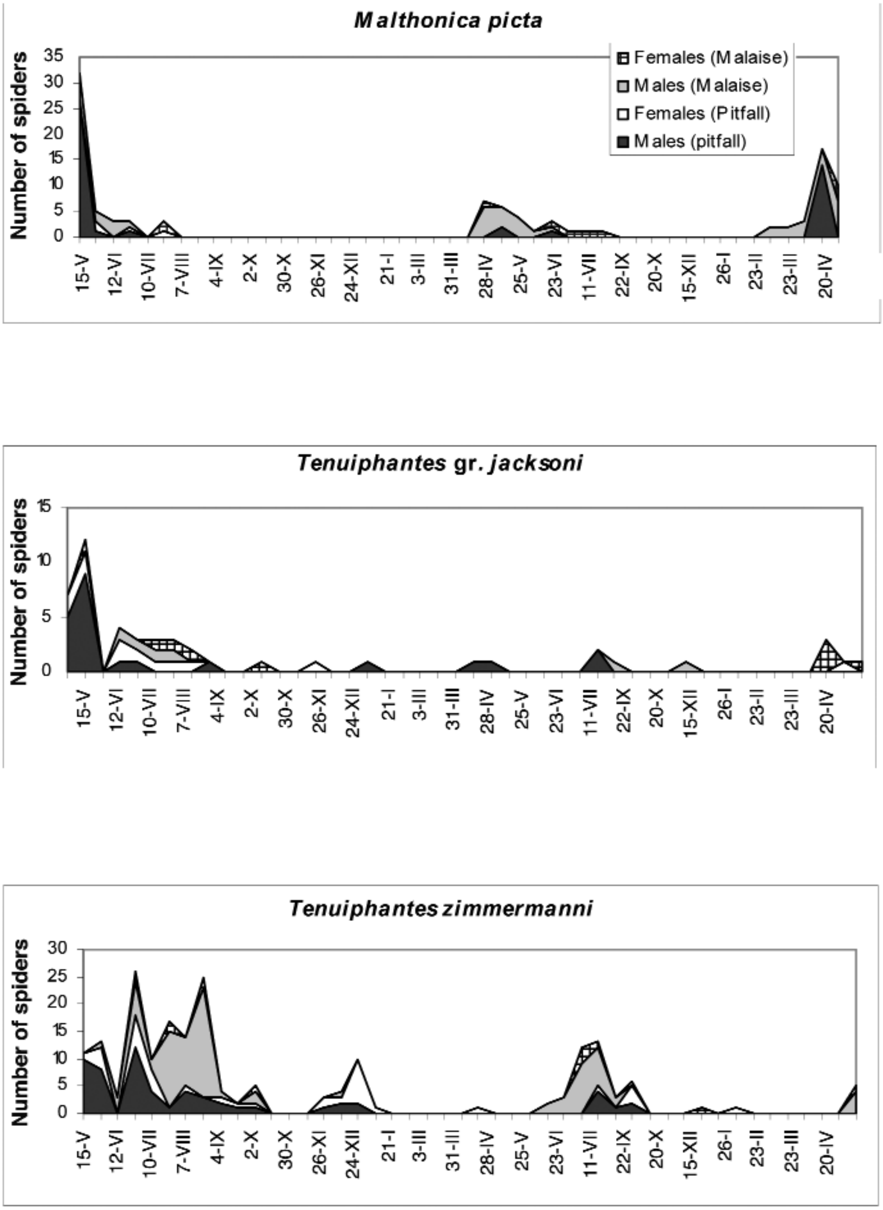
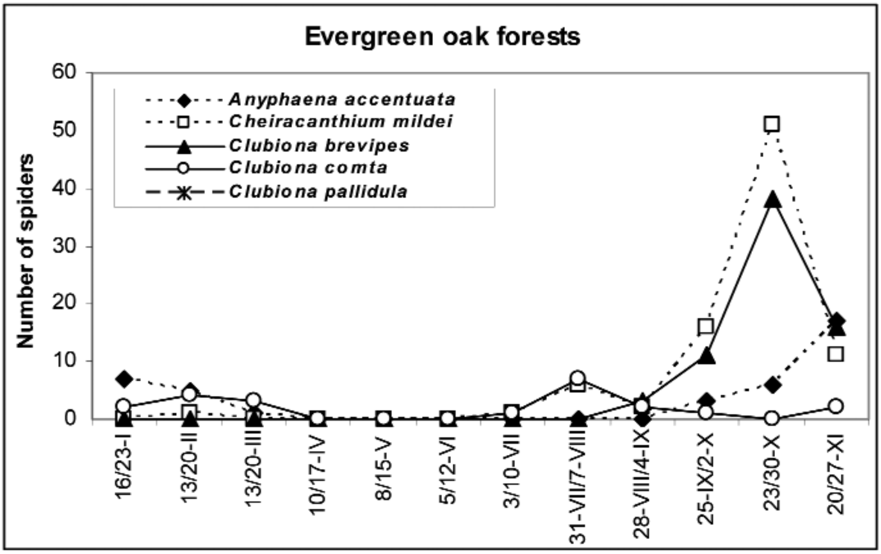


Figure 7.- Seasonal dynamics of species collected in high numbers in Malaise traps and epigeal pitfall traps (Artikutza).



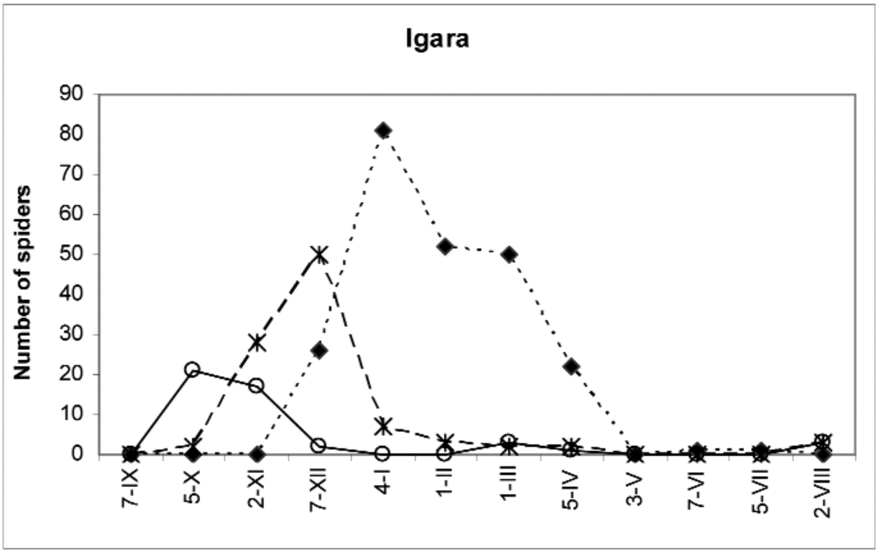


Figure 8.- Seasonal dynamics of immature specimens of species caught in high numbers using bark traps.

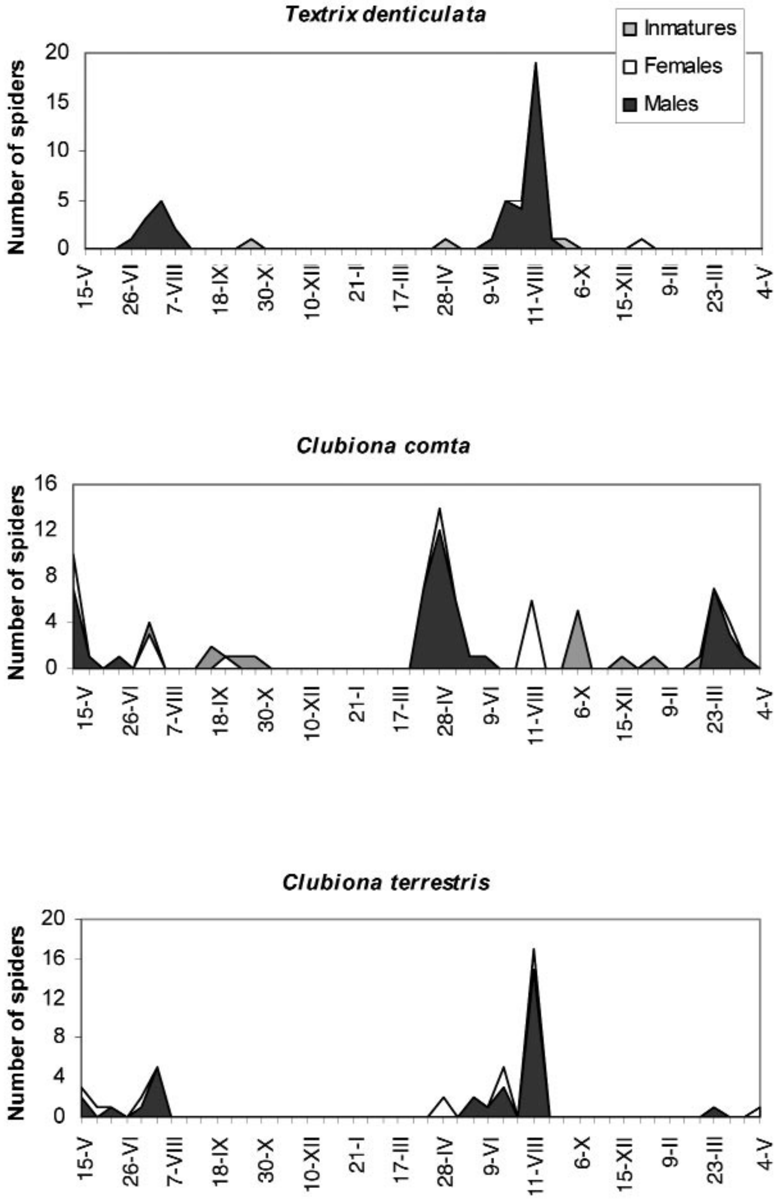


Figure 9.- Seasonal dynamics of some species during two consecutive sampling years (Artikutza: Malaise traps).

Vertical distribution of the species: Several species were active in more than one forest stratum. This was the case of *Malthonica picta*, *Tenuiphantes* cf. *jacksoni*, *T. zimmermanni* (Figure 7) and *T. flavipes*. In Artikutza, these species were caught both in pitfall and Malaise traps. But in the evergreen oak forests, they were not collected, or only sporadically collected, in trunk pitfall traps and bark traps, and never reached the tree foliage and liana stratum. In contrast, *Clubiona comta* and *Saitis barbipes* were caught by all kinds of collecting methods. *Dysdera fuscipes*, *Harpactea hombergi*, *Neon robustus* and *Saitis barbipes* were also active in both

Site and sampling methods	Whole sampling period	Dates that showed the highest species richness			The two consecutive dates that showed the highest species richness		
	Richness	Dates	Richness	%	Dates	Richness	%
Gorbea							
K	25	I	11	44.00	XII-I	14	56.00
Artikutza							
First cycle							
P	30	15 V	18	60.00	15-29 V	22	73.33
M	45	26 VI	14	31.11	26 VI-10 VII	21	46.67
P + M	62	15 V	25	40.32	15 V	35	56.45
Second cycle							
P	16	20 IV	7	43.75	6-20 IV	7	43.75
M	42	9 VI	16	38.10	26 V-9 VI	21	50.00
P + M	47	9 VI	17	36.17	26 V-9 VI	22	46.81
Total							
P	32	15/12 V	18	56.25	15/12-29/26 V	22	68.75
M	61	12/9 VI	20	32.79	29/26 V-12/9 VI	30	49.18
P + M	74	29/26 V	28	37.84	29/26 V-12/9 VI	41	55.41
Evergreen oak forests							
P	54	22/29 V	16	29.63	8/15-22/29 V	22	40.74
TP	30	5/12 VI	9	30.00	5/12-19/26 VI	13	43.33
BT	17	28 VIII/4 XI and 25 IX/2 X	5	29.41	3/10 VII-28 VIII/4IX and 28 VIII/4 IX-25 IX/2 X	7	41.18
P + TP	73	5/12 VI	22	30.14	5/12-19/26 VI	30	41.10
P + BT	63	3/10 VII	18	8.57	8/15-22/29 V and 22/29 V-5/12 VI	22	34.92
TP + BT	39	3/10 VII	10	25.64	3/10-17/24 VII	14	35.90
P + TP + BT	80	3/10 VII	24	30.00	5/12-19/26 VI and 19/26 VI-3/10 VII	30	37.50
Igara							
BT	12	XI and V	4	33.00	V-VI	6	50.00

Table V.- Observed species richness (only in adult phase) with each sampling method (or by combining more than one) in the whole sampling period and during the periods of highest species richness. Abbreviations: see Table II. In Artikutza, the first cycle ran from 15 May 1995 to 28 April 1996, and the second from 12 May 1996 to 20 April 1997.

environments, epigeal and tree trunks and the latter extended its activity to tree foliage. Despite showing vertical displacement, other species such as *Pallidupbantes cernuus*, showed greater activity in lower strata, while *Episinus maculipes*, *Labulla flahaulti* and *Textrix denticulata* were mainly found in upper strata.

All the most abundant species with long mating period (2 seasons or more) were found in the coger vegetation strata. The only exception was *Tenuiphantes zimmermanni.* However, this species was only caught in large numbers in Malaise traps, being sporadically found in bark traps and totally absent in trunk pitfall traps and beating samples.

Differences between consecutive years: In Artikutza, there were differences in abundance within species between the first and the second year (Appendices II and III). Higher numbers of individuals were registered by pitfall traps in the first year for almost all the most abundant species: *Malthonica picta*, *M. lusitanica*, *Coelotes terrestris*, *Tenuiphantes* cf. *jacksoni*, *T. zimmermanni* and *Pardosa lugubris.* The only exception was *Nemesia simoni*, where the trend was just the opposite (Figure 6). On the contrary, with the exception of *Tenuiphantes zimmermanni*, catches in Malaise traps were more numerous on the second year for the most abundant species: *Malthonica picta*, *Textrix denticulata*, *Clubiona comta* and *Clubiona terrestris.*

Within each species, main male activity did not vary more than one month between different years and places. In *Nemesia simoni* (Figure 6), the main activity always took place in October (though it extended to November in 1996). In *Coelotes terrestris* this period occurred in September; in *Malthonica picta* (Figure 7) and *Pardosa lugubris* it varied from April to May; and in *Clubiona terrestris* and *Textrix denticulata* (Figure 9), it took place from July to August (but it is possible that the July peak did not vary, given that in the second year, a July sample was missing in Artikutza). Only *Clubiona comta* showed larger oscillations, with the main male activity between late March and mid-May depending on the year. However, a lack of samples before May in 1995 in Artikutza may have led to an earlier activity peak for this species being missed.

DISCUSSION

Faunistic contribution: The capture of the following new species for the Iberian Peninsula and Spain was not surprising, since all are widespread in Europe (CANARD, 2005), and have already been recorded from the south of France: *Centromerita bicolor* had been registered from several locations in the French Pyrenees (BOSMANS & DE KEER, 1985; LEDOUX *et al.*, 1996; LE PERU, 2007), *Peponocranium ludicrum* is common in the Atlantic side of France (LE PERU, 2007) and has been recently recorded in Portugal (CARDOSO *et al.*, 2008). *Micrargus apertus* is a less frequent species, usually recorded in forest ecosystems in Europe (HÄNGGI *et al.*, 1995), but in France it is only known in the Department of Pyrénées Orientales (MILLIDGE, 1975).

The nearest record for the fourth species, *Midia midas*, is in a forest in the Department of Seine-et-Marne (SIMON, 1884, 1914-1937), in the north of France. There are more scattered citations of *Midia midas* in Central and Atlantic Europe (CANARD, 2005). The species is considered an old growth forest specialist (DUFFEY, 1993; HARVEY *et al.*, 2003). According to these authors, *Midia midas* seems to be confined to senescent trees, living in loose bark, dead wood, litter inside cavities of beeches and oaks, and in the nests of birds and squirrels. Corroborating these data, *Midia midas* was found in the forest of Artikutza, the only one with a large amount of dead wood caused by a lack of forestry work over more than 70 years at the time of sampling (MARTÍNEZ DE MURGUÍA *et al.*, 2002). Only one specimen was found, collected by Malaise traps. More specimens would probably have been found if the oldest trees in the forest had been sampled.

Despite finding 14 endemic species or with South-western European distribution, their presence in the study area was expected, because it is included in their known geographic distribution.In any case, the capture of *Bordea negrei* is remarkable, since hitherto all known citations have been from caves (BOSMANS, 1995). Surprisingly, the only individual caught was found in a pitfall trap in Artikutza, where the soil has no connection to a subterranean cavernicolous environment, because of the substrate of intrusive rocks characteristic of this area (CATALÁN *et al.*, 1989).

Seasonal dynamics: In agreement to the literature reviewed the species richness peak of active adult specimens takes place in the temperate part of the central and atlantic Europe between May and June: In Germany in several strata (TRETZEL, 1954), in Denmark for several strata pooled (TOFT, 1976), and in Portugal in epigeal stratum (CARDOSO, 2004; CARDOSO *et al.*, 2007). However, this pattern is broken in mediterranean places as in west-central Spain, where the main epigeal activity takes place in June-August, with the maxima in August (JERARDINO *et al.*, 1988). Likewise, in boreal climates like in Finland, there is also a delay in the peak of species richness, which occurs between June and July (NIEMELÄ, 1994).

The later occurrence of maximum richness in upper strata has also previously been observed: In German forests, epigaeic richness extends from April to June, and trunk-canopy richness from June to July (ALBERT, 1982). LUCZAK (1959), sampling the ground flora with a sweep net in Polish pine forests, found June to be the period of main diversity. HOREGOTT (1960) sampled the arboreal stratum of a German pine forest and concluded that the diversity peaks in July-August. Although they do not provide data on seasonal variations in species richness, other studies report the same months within the peaks of maximum adult spider abundance: in Germany, May-September in the epigeal stratum and May-July in the trees (ALBERT, 1982) and in Austria May-July in the epigeal stratum (NOFLATSCHER, 1993).

All of these results were expected, since most species breed between the spring and summer in most European countries: Germany (SCHAEFER, 1977), Austria (NOFLATSCHER, 1993), Belgium (BAERT & KEKENBOSCH, 1982; BAERT *et al.*, 1983), Finland (PALMGREN, 1972) and Norway (HAUGE, 2000).

In this work, whereas the May-June peak is due almost exclusively to the activity of adult spiders, the second relative maximum, usually in autumn, is the result of active immatures in period of dispersal, most probably looking for overwintering shelters (SCHAEFER, 1977). These immatures probably come from females that mated in spring and summer (LUCZAK, 1959). At this time, there are also some adults in breeding activity and others looking for sites in which to overwinter (TOFT, 1976; SCHAEFER, 1987). The sum total of the adults' activity causes the autumn peak observed in Artikutza. This second maximum has also been observed in several localities in Portugal, specifically in October (CARDOSO, 2004; CARDOSO *et al.*, 2007).

Results from litter samples and bark traps reflect other dynamics apart from seasonal reproductive displacements. For example, linyphiids are the most abundant and diverse family in litter samples in Gorbea. Among them, several species breed in the fall or winter (SCHAEFER, 1976; CARDOSO, 2004). In addition, other species overwinter in the litter (SCHAEFER, 1977), explaining the winter maximum observed. The summer minimum coincides with the driest season. This condition reduces the presence of linyphiids (HAUGE, 2000). Summer is also the season when the least amount of litter is available on the forest floor (GABBUT, 1956) and higher amounts of litter are usually positively linked with diversity in of spiders (UETZ, 1979).

The autumn movements of species looking for overwintering sites (DUFFEY, 1969; PEKÁR, 1999b; HORTON et al., 2001; HORVÁTH & SZINETÁR, 2002) are responsible for the maximum species richness observed in this season using bark traps. As the each species' activity ends, diversity falls during the winter, to a January-February minimum. From then on, there is activity among more species in adult stages, and thus juveniles mature or disperse to other strata or environments. As a result, there was a second peak of adults in spring-summer. During the warm season some species breeded or feeded in tree trunks: *Textrix denticulata*, *Harpactea hombergi*, *Clubiona comta*, *Labulla flahaulti*, *Segestria bavarica* and *Neon robustus.* Some of them were not present in the Igara samples, causing a relative summer minimum. In the autumn, several of these species disappeared and displacements of immatures looking for overwintering sites started again.

Seasonal dynamics of the species: Usually, species with long-reproductive periods do not concentrate them in one specific time of the year (SCHAEFER, 1987).

This is the example of the mating period of *Tenuiphantes flavipes*, as observed by several authors (MERRETT, 1969; JOCQUÉ, 1973; RIBERA & HORMIGA, 1985). The species appears to be very flexible in this regard since peaks of males can occur at different times of year, according to different studies: winter (TOFT, 1976), June (SCHAEFER, 1976), and even in two different periods of the year, May-July and October-November (HARVEY *et al.*, 2002). The principal mating period of *Palliduphantes cernuus* extends from late spring to the beginning of summer, according to specimens collected in the Pyrenean foothills, Jaca, Spain (RIBERA & HORMIGA, 1985). But in Jaca, the species shows two differences with regard to this study: a second peak of males between December-February, and an adult minimum extending from August to November. There are also differences between the two Spanish areas in the seasonal dynamics of *Chorizomma subterraneum*. In Jaca, the mating period is between August and December, with a maximum between August and October (BARRIENTOS, 1985b). But in the study area this period extends to May, with three maxima observed: September-October, December-January (peak of male activity), and February-April (secondary peak interrupted by a slight drop in March). In Jaca, *Chorizomma subterraneum* has been collected in damp low-altitude forests, and is more common in floors with thick layers of moss and needles. This, combined with its troglophilous character (RIBERA, 1980), leads one to think that *Chorizomma subterraneum* is a stenotopic species looking for damp habitats with narrow temperature margins throughout the year (BARRIENTOS, 1985b). The colder winter of Jaca would probably prevent activity of the species, at least on the epigaeic layer. In the Basque Country, its life cycle seems to have an overlap of three generations per year, thus each mating peak is followed by an activity of females and a consecutive peak in abundance of immatures, which remain inactive in the litter during the cold season (Figure 5).

Data from the literature shows greater consensus in the case of *Tenuiphantes zimmermanni* and *Malthonica lusitanica*. Both species have a minimum reproductive activity in winter, with two main mating periods between spring-summer and late summer-autumn. However, in *Malthonica lusitanica*, the spring-summer activity of males can be greater—as in Portugal (BARRIENTOS & CARDOSO, 2007) and Artikutza—or smaller than the late summer-autumn peak, as in Jaca, Spain (BARRIENTOS, 1985a,b) and the evergreen oak forests. In addition, BARRIENTOS (1985b) observed differences between habitats sampled at high and low altitudes within the same geographic area: at higher altitudes, males did not show spring-summer activity. Hence, what is always conservative is the late summer-autumn peak. BARRIENTOS (1985b) suggests that winter and spring breeding activity might be confined to deeper layers inside the litter. It has been observed that *Malthonica lusitanica* shows a clear preference for woodland habitats with a relatively deep litter and ground moss (BARRIENTOS & CARDOSO, 2007). In the litter and saxycolous moss of evergreen oak forests, adults are mainly concentrated in spring-summer (males only in spring), and immatures all year round (CASTRO, 2004b). In this kind of forest, pitfall traps show that each peak in males, even secondary ones, is followed by activity amongst females. These data suggest the presence of consecutive overlapping generations, as previously hypothesized (BARRIENTOS, 1985b).

Among species with short reproductive periods, only *Scotina celans* showed a peak in male activity that did not coincide with the data from the literature. According to the references consulted, the peak occurred between September and November, while in Cantabrian evergreen oak forests it occurs between December and February, with a presence stretching to April. Females were found all year round. The same was true for immatures, which abundantly colonized the saxycolous moss. In Brittany (France), CANARD (1984) found that adults started to be active at the beginning of the autumn, and the greatest population of this species had a biological cycle of two years, it being possible that one small portion completed it in a single year. It is possible that in the more moderate climate of the evergreen oak forests of the study area, the cycle could be mostly resumed in one year, with the first males maturing in the second half of the autumn. Only URONES (1985a) also finds a persistence of males from October to April in the Pyrenean foothills (northern Spain), but her data is made up of a small number of specimens, and they come from different habitats comprising a wide spectra of climatic conditions that may represent a mix of one and two-year cycles.

Within a given species, peaks of activity and density are often not coincident (HUHTA, 1965; 1971). This is the reason for the differences usually observed in the results obtained by pitfall traps and extraction of litter samples (HOVEMEYER & STIPPICH, 2000). For instance, *Gongylidiellum murcidum* shows a spring-summer breeding period, the male peak occurs in summer, and the presence of adults extends till the autumn (PALMGREN, 1972, 1976; PLATEN *et al.*, 1996). The data in PLATEN *et al.* are based on pitfall traps, and PALGREM's on litter sifting in the field throughout the year with the exception of the winter. According to the data collected in litter samples in Gorbea (Appendix I), males occurred in autumn and winter, and females all year round, with a peak of adults in January. This peak is in concordance with that obtained by WOZNY (1992) in the litter and moss of Polish pine forests. But this author does not break down the data into males and females. A possible interpretation of all these results may therefore be summarized as follows: there is activity of adults from the spring; the females that mate earlier could lay eggs from which spiders would hatch that become mature in the autumn. These individuals would overwinter—mainly inactively—in the litter, and be active again in spring and summer. This would explain the drop in density observed in Kempson litter samples, because litter extraction methods bias, above all, spiders that are inactive or show static hunting strategies (KOPONEN, 1976). The seasonal dynamics of *Micrargus apertus* were similar (Figure 6). According to HARVEY *et al.* (2002), in England the main breeding period of *M. apertus* is in spring and early summer, with sporadic presence of adults all year round. Even though they do not specify the sampling methods used to collect this species, it is likely that they reflect its activity. This winter activity, on mild, sunny days, is common in Central Europe (KIRCHNER, 1987). In accordance with the data obtained by BARRIENTOS *et al.* (1994), *Harpactea hombergi* is another species whose adults are mainly inactive in winter, but it overwinters in the evergreen oak forests, especially in the saxycolous moss.

Bark traps show displacements of spiders searching for overwintering sites (DUFFEY, 1969). As this researcher found, I observed that *Clubiona comta* also used bark traps for egg-laying (females with eggs observed in June and July samples), and *C. brevipes* as an overwintering site. In addition, Malaise traps shows that immatures of *C. comta* have more winter activity, being found in the litter, tree foliage, and mainly in tree trunks and arbustive stratum. Corroborating the data showed by KOOMEN (1998), immatures of *Anyphaena accentuata* were also active in winter, but more restricted to the arboricolous environment. As the findings of HORTON *et al.* (2001) and HORVÁRTH & SZINETÁR (2002) show, juveniles of *C. pallidula* and *Cheiracanthium mildei* also rested in the traps, being sporadically active in winter. Although most individuals from all these species overwinter as immatures, a few do so as adults. Presence of *C. terrestris* adults has been found in November, *C. comta* and *C. brevipes* till December, and *A. accentuata* in January. However, winter activity of adults has not been observed. The mere presence of adults in winter for some of these species is documented in the literature: *C. comta* (SCHAEFER, 1976; BARRIENTOS *et al.*, 1996; HARVEY *et al.*, 2002), *C. pallidula* (SCHAEFER, 1976), *C. terrestris* (SCHAEFER, 1976; TOFT, 1976, 1978a; HARVEY *et al.*, 2002), and *A. accentuata* (URONES *et al.*, 1995a; HARVEY *et al.*, 2002). On the other hand, Clubionidae, Miturgidae and Anyphaenidae spiders are all cursorial spiders. The lack of coincidence among activity peaks of spiders belonging to the same guild has been observed previously, and it supports the hypothesis of temporal stratification as a possible factor that explains their co-existence (TRETZEL, 1954; BUDDLE & DRANEY, 2004). However, at least within Clubionidae there is no evidence of intraguild predation on tree trunks (PEKÁR, 1999b). Hence, future research will be needed to test this hypothesis in the study area.

Because their life cycles are not well-known, a further discussion of the data obtained for the species *Nemesia simoni*, *Labulla flahaulti*, *Dipoena melanogaster* and *Episinus maculipes* is presented below:

Hitherto, sporadic records have given clues about the mating period of *Nemesia simoni.* The anecdotic observations of THOMAS (1999), who found 46 males (and any females) drowned in a swimming pool in the Department of Gironde (France) in a period of less than five days (12-16 September 1994), tallies with the data obtained in this work, where males of *Nemesia simoni* concentrate their activity from September to November, with a low number of additional captures till January in the evergreen oak forests.

The cycle of *Labulla flahaulti* fits with that of autumn stenochronous (SCHAEFER, 1977). Immatures were collected from late March, showing activity till August (Figure 6), when more individuals became sub-adults or adults. Throughout that time, they build their webs between large epigeal stones, barks and foliage of trees and bushes (CASTRO, 2004b). Adults are mainly found in tree trunks. Mating took place between the middle of summer and early autumn, when it was common to observe webs of both, males and females, in the same bark trap (personal observation). An egg-sac, found in Igara samples in October, suggests that autumn is the egg-laying period. No specimens were collected in winter, which indicates an annual cycle, overwintering in the egg phase.

Dipoena melanogaster shows a life cycle that falls into the spring and summer stenochronous category (SCHAEFER, 1977), which matches the findings of PLATEN *et al.* (1996). The mating period took place between May and July, with a peak in June. BARRIENTOS *et al.* (1996) indicate that mating occurs in summer, but without specifying which months. This species - only found in the Cantabrian evergreen oak forests in the present work – overwinters as immature stage in the foliage and branches of trees and shrubs, after showing a remarkable period of activity in the fall.

In the Cantabrian evergreen oak forests, *Episinus maculipes* males occurred in two different seasons: spring (from April to May) and summer (July-September). Adult females have also been registered at the same times. But in the Mediterranean evergreen oak forests of North-Eastern Spain, the mating period only takes place in summer (BARRIENTOS *et al.*, 1996). The species may show diplochrony depending on environmental conditions. The immatures were active in spring and summer on tree trunks, and in the autumn on forest litter where they probably overwinter. However, no individuals have been collected in litter samples, but several have been observed in branches near the forest floor in the cold season of the year.

Vertical distribution of the species: The greater proportion of juvenile specimens found in higher strata is explained by the scarcity of species with long breeding periods and by the low winter activity of adult individuals compared with the epigeal stratum. The higher proportion of species active in the adult stage at the lowest strata has previously been observed by several researchers (TRETZEL, 1954; PALMGREN, 1972; TOFT, 1976; ALBERT, 1982; CASTRO, 2004b). PALMGREN (1972) hypothesised that this pattern is due to the greater thermal stability of lower strata. HUHTA (1965) and BARRAQUETA (1985) show that air temperature oscillates more than that of the humus. Likewise, BRAUN (1992) found that higher parts of the trees are colder and drier, showing less diversity of spiders. MERRETT (1968) and TOFT (1976) argue that breeding periods are synchronized within each stratum with the period of maximum activity of prey. According to this, it has been observed that prey abundance is correlated with species richness of litter spiders, above all in spring and early summer (UETZ, 1975, 1979). Precisely, the prey capture by litter spiders is the greatest in spring months, a period of rapid growth and maturity for many species (MOULDER & REICHLE, 1972).

We can distinguish between the preferences of several spiders for specific strata. Like *Tenuiphantes flavipes* and *T. zimmermanni* (JOCQUÉ, 1973; TOFT, 1976), *Tenuiphantes* cf. *jacksoni* seems to colonize the plant strata just above the forest floor surface, as Malaise traps indicate. But none of these species seems to show an affinity for tree trunks, since they have rarely been collected in bark and trunk pitfall traps. Data from the literature (ALBERT, 1976; WUNDERLICH, 1982; MARC, 1990; BRAUN, 1992; HORVÁTH & SZINETÁR, 1998, 2002) corroborates this hypothesis for *T. flavipes* and *T. zimmermanni.* Although *T. flavipes* can spread to tree trunks, it prefers the epigeal stratum (SIMON, 1991). Taking pitfall traps as well, it is observed that *Malthonica picta* is active in both strata, and that *Coelotes terrestris* makes some vertical displacements, even to tree trunks (ALBERT, 1976). Even though *Clubiona terrestris* was only well represented in Malaise traps, TOFT (1978a) finds that it distributes in all strata in a Danish beech forest, as it was the case with *C. comta* in this study. Among the most abundant species found, the following are considered to be at least facultative trunk dwellers, according to the aforementioned literature: *Harpactea hombergi*, present in the forest floor too, *Textrix denticulata*, which also occurs in lower strata, and *Segestria bavarica*, *Dipoena melanogaster*, *Episinus maculipes*, *Paidiscura pallens*, *Keijia tincta*, *Labulla flahaulti*, *Anyphaena accentuata*, *Clubiona brevipes*, *C. pallidula*, *Philodromus rufus*, *P. aureolus*, *P. dispar* and *Diaea dorsata*, which are equally found in tree trunks, tree foliage and arbustive strata.

For the reasons explained in the section on material and methods, of all sampling methods applied, only Malaise traps are not of widespread use among arachnologists. It therefore seems appropriate to discuss some of the properties of the method. According to the results observed, Malaise traps yield a high number of species, requiring active displacements of spiders to allow their capture. The faunistic composition recorded seems to correspond to that of the herb and bush forest strata surrounding the traps, as also observed by JENNINGS & HILBURN (1988); it is not possible to relate the species collected with any particular microhabitat. All these properties suggest that pitfall and Malaise traps perform similarly and therefore the same remarks on the interpretation of the results obtained apply to both. It is also important to point out that spiders account for only 0.11-0.12% of all arthropods captured in Malaise traps (PUJADE, 1996; SCHNEIDER & DUELLI, 1997), and therefore this method is not recommended if the main focus of the study is the spider fauna. Nonetheless, when available, data from Malaise traps should not be neglected, since in some forests the highest species richness of spiders has been observed in low understorey strata (TURNBULL, 1960). Of the 77 species collected in the beech forest of Artikutza, 34 (44.16%) were registered by pitfall traps and 64 (83.12%) by Malaise traps. These percentages tally quite closely with those found in a German beech forest (ALBERT, 1976): 42.35% by pitfall traps and 78.82% by arboreal photoeclectors (85 species collected). In the Cantabrian evergreen oak forest 100 species have been found, 66 of which are present in the epigeal strata and 55 above this level (CASTRO, 2004b). The data obtained therefore highlights the need to sample above epigeal stratum to get a complete inventory of spider fauna. Regarding future research, it would be advisable to compare Malaise traps with other sampling methods well recognised as being effective in registering spiders active in low forest strata, such as emergency traps (ASCASO & BARRIENTOS, 1986; HÖVEMEYER & STIPPICH, 2000) and arboreal photoeclectors (ALBERT, 1976).

Differences between consecutive years: The differences found in pitfall trap samples in Artikutza between two consecutive years, both in terms of the number of specimens and the species observed, may be explained by several factors: one could be the weather conditions, since the second year was rainier and colder than the first (MARTÍNEZ DE MURGUÍA *et al.*, 2001). In Finland, KOPONEN *et al.* (1974) found a positive correlation between temperature and spider activity, though NIEMELÄ *et al.* (1994) do not, even though the latter observe a negative correlation with rainfall. MERRETT (1968) also observed a decrease in the activity of lycosid spiders during rainy periods. Data from field experiments in a temperate forest in the eastern USA also show a reduction in activity for gnaphosids in certain litter layers (LENSING *et al.*, 2005). Although in Portugal, CARDOSO *et al.* (2007) obtained a negative correlation between species richness and rainfall, they did not find temperature to have a significant influence. Although temperature and rainfall might explain the lower activity observed in pitfall traps in the second year, they do not explain why these differences are not so evident in Malaise traps. Several species were caught even more abundantly in the second year by Malaise traps. This effect might be due to the attraction this kind of trap holds for spiders as a sheltering microclimate, a focus of concentration of potential prey and their complex architecture (JENNINGS & HILBURN, 1988). Pitfall-trap sampling intensity is another factor that might depress the populations of the most active species (CANARD, 1981).

Within short-mating period species, slight differences in the occurrence of peak activities of males in consecutive years have also been observed by several authors. In Germany, TRETZEL (1954) found oscillations of one or two months, arguing that it is due to variations in temperature. AITCHINSON (1984) observed differences of two weeks in lycosid spiders in Canada, while BUDDLE & DRANEY (2004) recorded even fewer differences for dominant linyphiids in the same country. RUSSELL-SMITH & SWANN (1972) compared seasonal peaks from England and Germany, obtaining differences that did not exceed of one month. As explained previously, short-mating period species comprised the majority found in the samples, and also in temperate latitudes, and the life cycle of most of them (spring and summer stenochronous and diplochronous) is controlled by photoperiod, besides temperature (SCHAEFER, 1977; KISS & SAMU, 2002). This would explain why the activity peaks are so conservative, and why the main predictive factor of species richness over time is the length of the day, as found by CARDOSO *et al.* (2007).

Activity minima took place in winter, coinciding with the coldest months of the year in the study area: January and February (MARTÍNEZ DE MURGUÍA *et al.*, 2001; CASTRO, 2004b). These months are usually rainy, but the winter of 1997 was warmer and drier than the previous year in Artikutza (MARTÍNEZ DE MURGUÍA *et al.*, 2001). This would explain the relative maximum observed in the winter of 1997. The presence of relative maxima in winter in the study area is not surprising, given the activity of spiders observed in boreal regions on mild days at this time of the year (HUHTA & VIRAMO, 1979; AITCHINSON, 1984). Species whose activity is more dependent on temperature, or on complex interactions between temperature and photoperiod, might interrupt their simple dormancy in warmer-than-usual days in winter (SCHAEFER, 1977).

Conclusions and further research: With the aim of applying the indicative value of spider diversity in environmental management and conservation, a thorough knowledge is needed of the representative fauna of the forests in the study area. To save resources, budget and time, samples should be concentrated in the periods of the year that yield the most productive results. Most European literature on the topic suggests that peaks of species-richness at adult stage, and consequently the highest proportion of identifiable specimens, occur in May-June. In the study area, in the transition between these months (4 weeks), it is possible to collect around half of the species recorded in a systematic sampling comprising an entire year (similar to the percentages found by SCHARFF *et al.* (2003) and CARDOSO *et al.* (2007)), though according to the literature revised, it would theoretically be possible to collect a proportion closer to 94%.

However, as SCHARFF *et al.* (2003) show, for a specific month, even short intensive three-day sampling protocols can yield results that are as good as two months of systematic collection carried out at two-week intervals. Thus, for future studies, the available data from the Cantabrian evergreen oak forests and Artikutza will make it possible to estimate the performance of short-intensive sampling protocols proposed by several researchers (CODDINGTON *et al.*, 1991, 1996; SORENSEN *et al.*, 2002; SCHARFF *et al.*, 2003; CARDOSO *et al.*, 2008). If these protocols prove effective, considerable material and economic resources could be saved in future research.

It should also be borne in mind that as observed in Artikutza, both the number of individuals and the species richness registered may vary between consecutive years in the same study site. For this reason, this study can be used as a starting reference work that can be used to check whether the yield for a specific year in future short intensive sampling protocols is significantly lower than expected.

Finally, another factor to be taken into account is the forest stratum. Results indicate May (the middle half as the most favourable period) as being the best month to capture the highest species richness in the epigeal stratum (pitfall traps), the May-June transition for the low understorey vegetation (Malaise traps), and June for tree trunks (trunk pitfall and bark traps). When limited resources lead to a focus on a specific stratum, sampling the epigaeic community seems the advisable option in Mediterranean-type forests in the Iberian Peninsula, since it contains the highest diversity and rate of endemics (CASTRO, 2004b, CARDOSO *et al.*, 2007). Nevertheless, this may not be generalized to temperate woodlands since more species richness has been observed in upper strata in Artikutza and other beech forests (ALBERT, 1976). Further research combining several sampling methods in different kinds of forests in the study area is needed to determine whether most diversity and endemic species are generally concentrated in the epigeal stratum.

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TAXA	5/1982	6/1982	7/1982	8/1982	9/1982	10/1982	11/1982	12/1982	1/1983	2/1983	3/1983	4/1983	5/1983	6/1983	TOTAL
AGELENIDAE															
Malthonica lusitanica		2f 1	2	5	3	1	2					2			2f 16
Textrix denticulata												2			2
Undetermined inmatures	1	3	2			1		1		1	2				11
ATYPIDAE															
Atypus affinis		2	1		1		4	6			4	1	3	1	23
CLUBIONIDAE															
Clubiona comta							1	1m			1	1f			1m 1f 2
Clubiona terrestris							1m								1m
DICTYNIDAE															
Chorizomma subterraneum	2	12	3	1	14	2m 9	2f 13	5	2	1f 32	20	1f 10	1	4	2m 4f 128
GNAPHOSIDAE															
Zelotes sp.							1								1
HAHNIIDAE															
Hahnia nava					1	3						1	2		7
LINYPHIIDAE															
Centromerita concinna					1f	3f			1 f						5f
Centromerus albidus		1f													1f
Centromerus dilutus	2f	1f				6f	9m 15f	7m 20f	3f	2m 5f	7f	2f		1f	18m 62f
Cnephalocotes obscurus		1f							1 m						1m 1f
Entelecara aestiva		1m													1m
Gongylidiellum murcidum	4f		1f		1m 1f	1m 1f	1m	2f	7m 19f	2m 2f	2m	2m 3f	2f	2f	16m 37f
Maso sundevalli			1f				1f								2 f
Micrargus apertus	2m 3f	1m 1f	1f			1f		2 m 2f	4 m 4f	1m 2f	4f	1f			10m 19f
Minyriollus pusillus							1f							1m	1m 1f
Monocephalus fuscipes								1m 1f	1f	1f					1m 3f
Pocadicnemis juncea														2f	2f
Saaristoa abnormis	1m	1m	1m 1f									1f		1m	4m 2f
Tenuiphantes cristatus							1m								1m
Tenuiphantes zimmermanni	1f							1m	1f						1m 2f
Walckenaeria acuminata									3f	1f					4f
Undetermined inmatures	45	58	19	63	45	48	33	50	61	15	29	6	4	27	503
LIOCRANIDAE															
Undetermined inmatures				3	1										4
LYCOSIDAE															
Aulonia albimana	1m			2	2	2	1	1				1	1	1f	1m 1f 10
Pardosa sp.			3		1		1						1		6
Trochosa terricola			1f 3	4	1f 1			1m 2	1						1m 2f 11
MIMETIDAE															
Ero sp.							1								1
NEMESIIDAE															
Nemesia simoni	1								1						2
SALTICIDAE															
Neon reticulatus	1f	1m 1f		16	1	1			1f	1	1	1f			1m 4f 20
Undetermined inmatures							2						1	1	4
THERIDIIDAE															
Enoplognatha thoracica	1m 1f	1f										1m	1m		3m 2f
Pholcomma gibbum									1f						1f
Robertus lividus		1f		1	2	1f 7		1f 1	1f 2	3	1	2	3	1f 1	5f 23
Undetermined inmatures	3			2				4	2	1	1		1		14
THOMISIDAE															
Diaea sp.				1											1
ZORIDAE															
Zora sp.			1			1					1				3
Undetermined families															
Undetermined inmatures			6								5			5	16

Appendix I.- Breakdown of the catches made in the litter layer in Gorbea using the Kempson method. Abbreviations: m = males, f = females. Numbers without letter = immatures.

TAXA	5/15/1995	5/29/1995	6/12/1995	6/26/1995	7/10/1995	7/24/1995	8/7/1995	8/21/1995	9/4/1995	9/18/1995	10/2/1995	10/16/1995
AGELENIDAE												
Malthonica lusitanica	7m	4m		2m	2m		1m	1f		1		1m
Malthonica picta	26m 1f	1m 2f		1m 1f 1		1f						1
Tegenaria inermis	1									1		
Textrix denticulata							3m					
AMAUROBIIDAE												
Coelotes terrestris	1m 1f 3	3f 2	2	6		4	2m 13	11m 8	19m 3	19m 1	14m 1f 1	2m
CLUBIONIDAE												
Clubiona comta												
Clubiona terrestris	1f											
Undetermined inmatures												
DICTYNIDAE												
Chorizomma subterraneum	1f 1		1f							2f	1m 1f	
LINYPHIIDAE												
Bordea negrei												
Centromerita bicolor												
Diplocephalus latifrons	1m				1f							
Diplocephalus picinus		1m						1f				
Drapetisca socialis												
Micrargus apertus	1m											
Microneta viaria	1m 1f											
Monocephalus fuscipes	4m	2m 2f	1m 1f		1f							
Palliduphantes cernuus					1m							
Pocadicnemis juncea				1m								
Saaristoa abnormis	1m	2m 1f										
Tenuiphantes cf. *jacksoni*	5m 2f	9m 2f		1m 2f	1m 1f	1f	1f	1f	1f			
Tenuiphantes flavipes		2m 1f	1f	1m					2m 2f	1f		1m
Tenuiphantes tenuis					1f							
Tenuiphantes zimmermanni	10m 1f	8m 4f		12m 6f	4m 4f	1m	4m 1f	3m	2m 1f	1m 1f	1m 1f	
Walckenaeria corniculans			1m						1f			
Walckenaeria cucullata		1f										
Walckenaeria dalmasi	3m											
Undetermined inmatures	1				1			1	1		3	
LYCOSIDAE												
Pardosa lugubris	235m 15f 2	9m		2m 1f		1f			1f			
Pardosa nigriceps												
Pardosa pullata	1m											
NEMESIIDAE												
Nemesia simoni	1					1				1m	4m 1	3m
SALTICIDAE												
Ballus chalybeius	1m											
TETRAGNATHIDAE												
Metellina mengei	1m											
THERIDIIDAE												
Robertus lividus	1h											
Steatoda triangulosa		1f										

Appendix II.- Breakdown of the catches made using epigaeic pitfall traps in the forest of Artikutza. Abbreviations: m = males, f = females. Numbers without letter = immatures.

TAXA	10/30/1995	11/13/1995	11/26/1995	12/10/1995	12/24/1995	1/7/1996	1/21/1996	2/4/1996	3/3/1996	3/17/1996	3/31/1996	4/14/1996	4/28/1996
AGELENIDAE													
Malthonica lusitanica		5m		1m	3m						1m		
Malthonica picta					2								
Tegenaria inermis													
Textrix denticulata													
AMAUROBIIDAE													
Coelotes terrestris	4m 1f 1	2m 1	1f 1		1m				1f				
CLUBIONIDAE													
Clubiona comta													
Clubiona terrestris													
Undetermined inmatures											1	1	
DICTYNIDAE													
Chorizomma subterraneum													
LINYPHIIDAE													
Bordea negrei				1m									
Centromerita bicolor					4m 2f	1m 1f					1f		
Diplocephalus latifrons													
Diplocephalus picinus													
Drapetisca socialis													
Micrargus apertus													
Microneta viaria													
Monocephalus fuscipes				1m									
Palliduphantes cernuus													
Pocadicnemis juncea													
Saaristoa abnormis													
Tenuiphantes cf. *jacksoni*			1f			1m						1m	1m
Tenuiphantes flavipes			1f	3m								1m	
Tenuiphantes tenuis													
Tenuiphantes zimmermanni			1m 2f	2m 1f	2m 8f	1f						1f	
Walckenaeria corniculans													
Walckenaeria cucullata													
Walckenaeria dalmasi													
Undetermined inmatures				3									
LYCOSIDAE													
Pardosa lugubris													
Pardosa nigriceps													
Pardosa pullata													
NEMESIIDAE													
Nemesia simoni				1									
SALTICIDAE													
Ballus chalybeius													
TETRAGNATHIDAE													
Metellina mengei													
THERIDIIDAE													
Robertus lividus													
Steatoda triangulosa													

Appendix II. Continuation.

TAXA	5/12/1996	5/26/1996	6/9/1996	6/23/1996	7/14/1996	8/11/1996	8/25/1996	9/22/1996	10/6/1996	10/20/1996
AGELENIDAE										
Malthonica lusitanica									1	
Malthonica picta	2m			1m			1			
Tegenaria inermis										
Textrix denticulata										
AMAUROBIIDAE										
Coelotes terrestris		1		1	1f 3	1f 3	11m	15m 1	3m	2m
CLUBIONIDAE										
Clubiona comta										
Clubiona terrestris					1f					
Undetermined inmatures										
DICTYNIDAE										
Chorizomma subterraneum									1m	1m
LINYPHIIDAE										
Bordea negrei										
Centromerita bicolor										
Diplocephalus latifrons										
Diplocephalus picinus										
Drapetisca socialis								1m		
Micrargus apertus										
Microneta viaria										
Monocephalus fuscipes										
Palliduphantes cernuus										
Pocadicnemis juncea										
Saaristoa abnormis										
Tenuiphantes cf. *jacksoni*						2m				
Tenuiphantes flavipes									1f	
Tenuiphantes tenuis										
Tenuiphantes zimmermanni						4m 1f	1m	2m 3f		
Walckenaeria corniculans										
Walckenaeria cucullata										
Walckenaeria dalmasi										
Undetermined inmatures										
LYCOSIDAE										
Pardosa lugubris		6m	4m	2m 1f			1f			
Pardosa nigriceps										
Pardosa pullata										
NEMESIIDAE										
Nemesia simoni						1			6m 1	7m
SALTICIDAE										
Ballus chalybeius										
TETRAGNATHIDAE										
Metellina mengei										
THERIDIIDAE										
Robertus lividus										
Steatoda triangulosa										

Appendix II. Continuation.

TAXA	11/17/1996	12/15/1996	1/12/1996	1/26/1997	2/9/1997	2/23/1997	3/7/1997	3/23/1997	4/6/1997	4/20/1997	5/4/1997	TOTAL
AGELENIDAE												
Malthonica lusitanica												1f
Malthonica picta			1				2m	2m 1	3m	3m	7m 3f	44m 10f 9
Tegenaria inermis	3m 1f									1m	1m 1	13m 5f 3
Textrix denticulata			1f									41m 2f 3
Undetermined inmatures												1
AMAUROBIIDAE												
Amaurobius similis												1m
Coelotes terrestris	1f								1f			2m 3f 1
ANYPHAENIDAE												
Anyphaena accentuata	1	1					1		1m		1m	2m 5
ARANEIDAE												
Araneus diadematus												2m 1f 3
Araniella cucurbitina												1m 1f
Zilla diodia											1f	1f
Undetermined inmatures	3	4	1									31
CLUBIONIDAE												
Clubiona caerulescens												1m
Clubiona comta		1		1			1	7m	3m 1f	1m		47m 16f 13
Clubiona brevipes												4m 4f 8
Clubiona pallidula												3m 8
Clubiona terrestris								1m			1f	31m 10f
Clubiona sp.	1	1									1	31
GNAPHOSIDAE												
Drassodes cupreus												1m
LINYPHIIDAE												
Diplocephalus latifrons							1m	1f	1m	1f		3m 2f
Drapetisca socialis												4m 4f 1
Erigone dentipalpis												1f
Labulla flahaulti												3m 1
Linyphia triangularis												1m
Meioneta mollis												1f
Meioneta rurestris												2m 1f
Micrargus laudatus												1f
Microneta viaria								1f				2f
Midia midas											1m	1m
Palliduphantes cernuus		1f										4m 4f
Parapelecopsis nemoralis												8m 3f
Peponocranium ludicrum					1							1m 1
Tenuiphantes cf. *jacksoni*	1m								3f		1f	6m 9f
Tenuiphantes flavipes			1f									7m 6f
Tenuiphantes mengei												1m 2f
Tenuiphantes tenuis	1m	1m								1m		11m 7f
Tenuiphantes zimmermanni		1f									4m 1f	86m 14f 1
Walckenaeria cucullata								4f				4f
Walckenaeria dalmasi							1f	1f				2f
Undetermined inmatures	6	5	5	6	5		3	4	2		1	220

Appendix II. Continuation.

TAXA	5/15/1995	5/29/1995	6/12/1995	6/26/1995	7/10/1995	7/24/1995	8/7/1995	8/21/1995	9/4/1995	9/18/1995	10/2/1995
AGELENIDAE											
Malthonica lusitanica											
Malthonica picta	5m	2m	3m	1m		2f					1
Tegenaria inermis		1m		1m						1m 1	1m
Textrix denticulata				1m	3m	5m	2m				
Undetermined inmatures											
AMAUROBIIDAE											
Amaurobius similis											1m
Coelotes terrestris								1m			
ANYPHAENIDAE											
Anyphaena accentuata											
ARANEIDAE											
Araneus diadematus									1m	1m	
Araniella cucurbitina					1m						
Zilla diodia											
Undetermined inmatures									1	1	1
CLUBIONIDAE											
Clubiona caerulescens											
Clubiona comta	7m 3f	1m		1m		3f 1				2	1f
Clubiona brevipes	1m 1	1	1m 1f	1m 1f							
Clubiona pallidula	1m										
Clubiona terrestris	2m 1f	1f	1m		1m 1f	5m					
Clubiona sp.	1	2		1			1			1	4
GNAPHOSIDAE											
Drassodes cupreus											
LINYPHIIDAE											
Diplocephalus latifrons											
Drapetisca socialis						1	1f	1f			3m
Erigone dentipalpis								1f			
Labulla flahaulti					1		2m				
Linyphia triangularis								1m			
Meioneta mollis											
Meioneta rurestris	1m								1m		
Micrargus laudatus											
Microneta viaria					1f						
Midia midas											
Palliduphantes cernuus						1m	1m 1f	1f			1f
Parapelecopsis nemoralis				1f							
Peponocranium ludicrum											
Tenuiphantes cf. *jacksoni*		1f		1m	1m	1m 1f	1m 1f	1f			
Tenuiphantes flavipes					1f	2m	1f	1m			
Tenuiphantes mengei		1m					1f				
Tenuiphantes tenuis	1f	1f	1f	1m		1m	1m				1m
Tenuiphantes zimmermanni		1m	3m	6m 2f	2m	14m 2f 1	9m	20m 2f	1m		2m 1f
Walckenaeria cucullata											
Walckenaeria dalmasi											
Undetermined inmatures	6	1	1	2		2		4			4

Appendix III.- Breakdown of the catches made using Malaise traps in the forest of Artikutza. Abbreviations: m = males, f = females. Numbers without letter = immatures.

TAXA	10/16/1995	10/30/1995	11/13/1995	11/26/1995	12/10/1995	12/24/1995	1/7/1996	1/21/1996	2/4/1996	3/3/1996	3/17/1996	3/31/1996	4/14/1996
AGELENIDAE													
Malthonica lusitanica													
Malthonica picta		1	3										
Tegenaria inermis	2m 1f	2m				1f 1	1f						
Textrix denticulata	1												
Undetermined inmatures		1											
AMAUROBIIDAE													
Amaurobius similis													
Coelotes terrestris		1f											
ANYPHAENIDAE													
Anyphaena accentuata				2									
ARANEIDAE													
Araneus diadematus			1f										
Araniella cucurbitina													
Zilla diodia													
Undetermined inmatures	1	3	3	1		2	2	2		3	1		
CLUBIONIDAE													
Clubiona caerulescens													
Clubiona comta	1	1											7m
Clubiona brevipes	1f 4		1f	1									
Clubiona pallidula		1										6	1
Clubiona terrestris													
Clubiona sp.	2			1	1	1				1			
GNAPHOSIDAE													
Drassodes cupreus													
LINYPHIIDAE													
Diplocephalus latifrons													
Drapetisca socialis	1m			1f									
Erigone dentipalpis													
Labulla flahaulti													
Linyphia triangularis													
Meioneta mollis													1f
Meioneta rurestris							1f						
Micrargus laudatus													
Microneta viaria													
Midia midas													
Palliduphantes cernuus													
Parapelecopsis nemoralis	1m	2m			3m								
Peponocranium ludicrum													
Tenuiphantes cf. *jacksoni*	1f												
Tenuiphantes flavipes		2m											1m
Tenuiphantes mengei									1f				
Tenuiphantes tenuis			1m 1f										
Tenuiphantes zimmermanni					1m								
Walckenaeria cucullata													
Walckenaeria dalmasi													
Undetermined inmatures	2	5	19	15	13	15	1	6	23	24	16	3	15

Appendix III. Continuation.

TAXA	4/28/1996	5/12/1996	5/26/1996	6/9/1996	6/23/1996	7/14/1996	8/11/1996	8/25/1996	9/22/1996	10/6/1996	10/20/1996
AGELENIDAE											
Malthonica lusitanica							1f				
Malthonica picta	6m 1f	4m	4m	1m 1	1m 1f	1f	1f	1f	1		
Tegenaria inermis							1f				
Textrix denticulata	1			1m	5m	4m 1f	19m	1m	1		
Undetermined inmatures											
AMAUROBIIDAE											
Amaurobius similis											
Coelotes terrestris				1					1m		
ANYPHAENIDAE											
Anyphaena accentuata											
ARANEIDAE											
Araneus diadematus							1		1		1
Araniella cucurbitina						1f					
Zilla diodia											
Undetermined inmatures							1				1
CLUBIONIDAE											
Clubiona caerulescens			1m								
Clubiona comta	12m 2f	6m	1m	1m			6f			5	
Clubiona brevipes			1			1m					
Clubiona pallidula		1m	1m								
Clubiona terrestris	2f		2m	1m	3m 2f		15m 2f				
Clubiona sp.	1			1			1	4	3	2	
GNAPHOSIDAE											
Drassodes cupreus				1m							
LINYPHIIDAE											
Diplocephalus latifrons			1m								
Drapetisca socialis							1f				
Erigone dentipalpis											
Labulla flahaulti									1m		
Linyphia triangularis											
Meioneta mollis											
Meioneta rurestris											
Micrargus laudatus						1f					
Microneta viaria											
Midia midas											
Palliduphantes cernuus	1m						1m				
Parapelecopsis nemoralis	1f			1m 1f						1m	
Peponocranium ludicrum			1m								
Tenuiphantes cf. *jacksoni*								1m			
Tenuiphantes flavipes		1f			1f					1f	1m
Tenuiphantes mengei											
Tenuiphantes tenuis				1m	2m					1f	1f
Tenuiphantes zimmermanni				2m	3m	9m 3f	7m 1f	2m	1f		
Walckenaeria cucullata											
Walckenaeria dalmasi											
Undetermined inmatures	1		2			1		1	1		

Appendix III. Continuation.

TAXA	11/17/1996	12/15/1996	1/12/1997	1/26/1997	2/9/1997	2/23/1997	3/7/1997	3/23/1997	4/6/1997	4/20/1997	5/4/1997	TOTAL
AGELENIDAE												
Malthonica lusitanica												1f
Malthonica picta			1				2m	2m 1	3m	3m	7m 3f	44m 10f 9
Tegenaria inermis	3m 1f									1m	1m 1	13m 5f 3
Textrix denticulata			1f									41m 2f 3
Undetermined inmatures												1
AMAUROBIIDAE												
Amaurobius similis												1m
Coelotes terrestris	1f								1f			2m 3f 1
ANYPHAENIDAE												
Anyphaena accentuata	1	1					1		1m		1m	2m 5
ARANEIDAE												
Araneus diadematus												2m 1f 3
Araniella cucurbitina												1m 1f
Zilla diodia											1f	1f
Undetermined inmatures	3	4	1									31
CLUBIONIDAE												
Clubiona caerulescens												1m
Clubiona comta		1		1			1	7m	3m 1f	1m		47m 16f 13
Clubiona brevipes												4m 4f 8
Clubiona pallidula												3m 8
Clubiona terrestris								1m			1f	31m 10f
Clubiona sp.	1	1									1	31
GNAPHOSIDAE												
Drassodes cupreus												1m
LINYPHIIDAE												
Diplocephalus latifrons							1m	1f	1m	1f		3m 2f
Drapetisca socialis												4m 4f 1
Erigone dentipalpis												1f
Labulla flahaulti												3m 1
Linyphia triangularis												1m
Meioneta mollis												1f
Meioneta rurestris												2m 1f
Micrargus laudatus												1f
Microneta viaria								1f				2f
Midia midas											1m	1m
Palliduphantes cernuus		1f										4m 4f
Parapelecopsis nemoralis												8m 3f
Peponocranium ludicrum					1							1m 1
Tenuiphantes cf. *jacksoni*	1m								3f		1f	6m 9f
Tenuiphantes flavipes			1f									7m 6f
Tenuiphantes mengei												1m 2f
Tenuiphantes tenuis	1m	1m								1m		11m 7f
Tenuiphantes zimmermanni		1f									4m 1f	86m 14f 1
Walckenaeria cucullata								4f				4f
Walckenaeria dalmasi							1f	1f				2f
Undetermined inmatures	6	5	5	6	5		3	4	2		1	220

Appendix III. Continuation.

TAXA	5/15/1995	5/29/1995	6/12/1995	6/26/1995	7/10/1995	7/24/1995	8/7/1995	8/21/1995	9/4/1995	9/18/1995	10/2/1995
LYCOSIDAE											
Aulonia albimana											
Pardosa lugubris											
Pardosa sp.											
PHILODROMIDAE											
Philodromus aureolus		1		1		1f	3				2
Philodromus buxi		1m									
Philodromus dispar											
Philodromus rufus		1m		1m			1				
Philodromus sp.		2								1	
SALTICIDAE											
Ballus chalybeius	1m										
Neon reticulatus						2f	2f				
Saitis barbipes				1m							
Undetermined inmatures								1			
SEGESTRIIDAE											
Segestria senoculata											
TETRAGNATHIDAE											
Metellina mengei				1m							
Metellina segmentata											1f
Metellina sp.						1					2
Undetermined inmatures											1
THERIDIIDAE											
Achaearanea lunata					1m						
Anelosimus vittatus											
Enoplognatha ovata					1m	1f					
Episinus maculipes											
Keijia tincta		1	1m	1m							
Paidiscura pallens			1f		1f						1
Pholcomma gibbum											
Robertus lividus											
Simitidion simile			1m								
Theridion mystaceum			1m								
Theridion pinastri							1m				
Undetermined inmatures					1						
THOMISIDAE											
Diaea dorsata		1	1								
Xysticus audax	1m			1m 1f	1m						
Xysticus cristatus		1f									
Xysticus lanio	1m										
Xysticus sp.		2	1				1				3
ZORIDAE											
Zora spinimana											

Appendix III. Continuation.

TAXA	10/16/1995	10/30/1995	11/13/1995	11/26/1995	12/10/1995	12/24/1995	1/7/1996	1/21/1996	2/4/1996	3/3/1996	3/17/1996	3/31/1996	4/14/1996	14/04/1996
LYCOSIDAE														
Aulonia albimana														
Pardosa lugubris											1			
Pardosa sp.														
PHILODROMIDAE														
Philodromus aureolus		4		1	2				1				1	
Philodromus buxi	2													
Philodromus dispar	1													
Philodromus rufus	1	2	2						2		1	1		1
Philodromus sp.		2									1			
SALTICIDAE														
Ballus chalybeius		1												
Neon reticulatus														
Saitis barbipes														
Undetermined inmatures														
SEGESTRIIDAE														
Segestria senoculata														
TETRAGNATHIDAE														
Metellina mengei		2m 1f		1m										
Metellina segmentata					1m									
Metellina sp.	1					1								
Undetermined inmatures		3	1	1	2	1					1			1
THERIDIIDAE														
Achaearanea lunata														
Anelosimus vittatus														
Enoplognatha ovata														
Episinus maculipes														
Keijia tincta		2		1					1					
Paidiscura pallens						1					1			
Pholcomma gibbum												1m		
Robertus lividus				1f	1						1			1m
Simitidion simile														
Theridion mystaceum		1			1									
Theridion pinastri														
Undetermined inmatures				1										
THOMISIDAE														
Diaea dorsata		3	1	1							1			1
Xysticus audax														
Xysticus cristatus														
Xysticus lanio														
Xysticus sp.	3	2										4		1
ZORIDAE														
Zora spinimana														

Appendix III. Continuation.

TAXA	4/28/1996	5/12/1996	5/26/1996	6/9/1996	6/23/1996	7/14/1996	8/11/1996	8/25/1996	9/22/1996	10/6/1996	10/20/1996
LYCOSIDAE											
Aulonia albimana											
Pardosa lugubris											
Pardosa sp.											
PHILODROMIDAE											
Philodromus aureolus	1			1m			1m		1		1
Philodromus buxi											
Philodromus dispar			1m	1m	1m	1					
Philodromus rufus						1					
Philodromus sp.											
SALTICIDAE											
Ballus chalybeius				1m							
Neon reticulatus							1f	1f			
Saitis barbipes					1m						
Sin determinar											
SEGESTRIIDAE											
Segestria senoculata											
TETRAGNATHIDAE											
Metellina mengei		2m 1f									
Metellina segmentata											
Metellina sp.											1
Undetermined inmatures		1								1	
THERIDIIDAE											
Achaearanea lunata											
Anelosimus vittatus		2							1f		
Enoplognatha ovata											
Episinus maculipes							1f				
Keijia tincta											
Paidiscura pallens				1f							
Pholcomma gibbum											
Robertus lividus				1m							
Simitidion simile											
Theridion mystaceum											
Theridion pinastri											
Undetermined inmatures											
THOMISIDAE											
Diaea dorsata	2		1m	1m							
Xysticus audax			1f	1m	1f						
Xysticus cristatus											
Xysticus lanio			1m	1f	1m						
Xysticus sp.		1	6	2	1	1		2			
ZORIDAE											
Zora spinimana											

Appendix III. Continuation.

TAXA	11/17/1996	12/15/1996	1/12/1997	1/26/1997	2/9/1997	2/23/1997	3/7/1997	3/23/1997	4/6/1997	4/20/1997	5/4/1997	TOTAL
LYCOSIDAE												
Aulonia albimana							1	1				2
Pardosa lugubris	1										1m,1f	1m 1f 2
Pardosa sp.							1					1
PHILODROMIDAE												
Philodromus aureolus	1	2		2			1					2m 1f 25
Philodromus buxi												1m 2
Philodromus dispar		1										3m 3
Philodromus rufus		1										2m 13
Philodromus sp.		1					1					8
SALTICIDAE												
Ballus chalybeius												2m 1
Neon reticulatus												6f
Saitis barbipes												2m
Undetermined inmatures												1
SEGESTRIIDAE												
Segestria senoculata	1m											1m
TETRAGNATHIDAE												
Metellina mengei		2f						1m				7m 4f
Metellina segmentata												1m 1f
Metellina sp.	1											7
Undetermined inmatures				1								14
THERIDIIDAE												
Achaearanea lunata												1m
Anelosimus vittatus												1f 2
Enoplognatha ovata												1m 1f
Episinus maculipes												1f
Keijia tincta												2m 5
Paidiscura pallens												3f 3
Pholcomma gibbum												1m
Robertus lividus		1					1m	1f		1f	1m	4m 3f 3
Simitidion simile												1m
Theridion mystaceum												1m 2
Theridion pinastri												1m
Undetermined inmatures									1			3
THOMISIDAE												
Diaea dorsata		1	1	1							1	2m 15
Xysticus audax												4m 3f
Xysticus cristatus												1f
Xysticus lanio											2m 2f	5m 3f
Xysticus sp.	1				1						1	33
ZORIDAE												
Zora spinimana									1m			1m

Appendix III. Continuation.

TAXA	9/7/2002	10/5/2002	11/2/2002	12/7/2002	1/4/2003	2/1/2003	3/1/2003	4/5/2003	5/3/2003	6/7/2003	7/5/2003	8/2/2003	TOTAL
AGELENIDAE													
Tegenaria inermis				1			1						2
Textrix denticulata	4	2	4	6	2		1	1	2	1m 1		1	1m 24
Undetermined inmatures		1		1	1								3
ANYPHAENIDAE													
Anyphaena accentuata				26	1f 81	52	50	2m 1f 22	6m 11f	1	1		8m 13f 233
ARANEIDAE													
Nuctenea umbratica					1f								1f
Juveniles sin determinar						1							1
CLUBIONIDAE													
Clubiona brevipes		1f	5f	1f 1			1					1f	8f 2
Clubiona comta		21	1f 17	2			3	1	4f	4f	4f	3	13f 47
Clubiona pallidula		2	28	50	7	3	2	2	1m			1f 3	1m 1f 97
Undetermined inmatures				5	1						1		7
DYSDERIDAE													
Dysdera fuscipes	3												3
Harpactea hombergi	1							1f	1f 1		6	2	2f 10
LINYPHIIDAE													
Labulla flahaulti	3m 14f	1m 11f	6f	1f				4	5	3	7	1m 3f 6	5m 35f 25
Parapelecopsis nemoralis							1m						1m
Tenuiphantes zimmermanni	1f												1f
Undetermined inmatures	3	1	1							1	1	3	10
MITURGIDAE													
Cheiracanthium mildei			1f 1										1f 1
PHILODROMIDAE													
Undetermined inmatures					1								1
SALTICIDAE													
Ballus chalybeius			3		1								4
Saitis barbipes											1	1	2
TETRAGNATHIDAE													
Metellina merianae										2f			2f
THERIDIIIDAE													
Theridula gonygaster		1		1	1								3
Undetermined inmatures			8	1		1	10		2		1	1	24
THOMISIDAE													
Undetermined inmatures								1					1
Undetermined families													
Undetermined inmatures	2												2

Appendix IV. Breakdown of the catches made using bark traps in the alder forest of Igara. Abbreviations: m = males, f = females. Numbers without letter = immatures.