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Benthic macroinvertebrate communities of diverse gravel pit ponds of the Southeast Regional Park of Madrid

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Benthic Macroinvertebrate Communities of Diverse Gravel Pit Ponds of the Southeast Regional Park of Madrid

Las Comunidades de Macroinvertebrados Bentónicos de Diversas Lagunas de Gravera del Parque Regional del Sureste de Madrid

Tesis doctoral

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Dedicatoria

Para mi familia y mi hija **RAHMA**

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Los ecosistemas de la Tierra están enormemente afectados por la presión antropogénica. Se estima que la utilización de los recursos naturales por parte del hombre se ha incrementado desde un 70% de la capacidad de regeneración de la biosfera en 1961 hasta aproximadamente un 120% en 1999. Este aumento de la presión tiene como resultado la destrucción, fragmentación y degradación de hábitats naturales, y la reducción de la biodiversidad global con tasas sin precedentes. Esta crisis de biodiversidad afectará dramáticamente al bienestar humano (Gabriels, 2007).

El Parque Regional del Sureste de la Comunidad de Madrid cubre un área de 31.550 ha en torno a los ejes de los cursos bajos de los ríos Manzanares y Jarama. En 1994 fue declarado espacio protegido por la Comunidad de Madrid (B.O.C.M., 1994) con el fin de proteger este área de todo tipo de impacto ambiental.

Entre los valores más destacados de este parque hay que reseñar la riqueza y diversidad de aves acuáticas, dependientes de las lagunas que se han formado en su mayor parte como consecuencia de la extracción de áridos (gravas, arenas, etc.). A lo largo de los años, estos medios acuáticos han ido siendo colonizados por animales y plantas, evolucionando hacia sistemas naturales. Toda esta zona ha sufrido una seria

degradación como consecuencia de las actividades urbanas, industriales, y agrícolas. El impacto más grande lo ha constituido la intensa actividad de extracción de grava; al ser designada el área como espacio protegido, se han prohibido las nuevas explotaciones. Simultáneamente, se están tomando medidas para disminuir el deterioro ambiental y regenerar las áreas más afectadas (Domínguez y Peña, 1999; Fernández *et al.*, 2000).

Fruto del interés que tienen los estudios y la conservación del Parque, y en particular de sus ecosistemas acuáticos, fue el inicio de una serie de trabajos realizados en el Centro de Investigaciones Ambientales de la Comunidad de Madrid "Fernando González Bernáldez" (CIAM) desde 1997. En primer lugar, se hizo un inventario, caracterización y valoración general de los humedales del Parque, que van desde manantiales hasta embalses y, sobre todo, lagunas de gravera. En dicho trabajo, quedó de manifiesto el número elevado de humedales presentes, un total de 123 y su gran variedad e importancia (Roblas y García-Avilés, 1997). Posteriormente, se realizó un estudio físico-químico de los ambientes estancados del Parque (Álvarez Cobelas *et al.*, 2000) y la biodiversidad de algunos órdenes de insectos (García-Avilés 2002a y 2002b).

Con el paso del tiempo y la colonización de fauna y flora, los humedales del Parque del Sureste toman cada vez más relevancia. Con este estudio, se pretende realizar una aportación al conocimiento de la entomofauna de estos cuerpos de agua. Para ello, se seleccionaron 16 lagunas (15 originadas por extracción de grava y arena, y una que fue el resultado de la explotación de yesos), también un embalse de riego y, por último, un pequeño manantial que supone prácticamente el único ejemplo de humedales naturales localizados en el área.

Las muestras proceden de muestreos trimestrales durante más de un año completo entre 1998-1999, explorando el bentos litoral exclusivamente, con muestras diferenciadas según los diversos tipos de vegetación presente en las orillas, así como en las zonas de aguas libres. Los muestreos se efectuaron con una red de mano, de 30 por 30 cm y luz de malla de 1 mm, realizándolos con carácter semicuantitativo, de esfuerzo por unidad de espacio (recorridos de 1 m). Además se han efectuado muestreos cualitativos para la captura de adultos de odonatos. Así mismo, se realizó otra campaña durante el mes de octubre de 2009 en 4 lagunas representativas.

Ya en el laboratorio, se procedió a la separación y su posterior identificación de un total de 76700 macroinvertebrados acuáticos provenientes de 387 réplicas de diferentes hábitats, con y sin vegetación (Apéndice 3).

La identificación se efectuó a nivel de familia en el caso de los Dípteros y a nivel específico en los restantes órdenes de insectos, es decir, en Efemerópteros, Odonatos, Heterópteros, Coleópteros y Tricópteros. El listado de todos los taxones estudiados aparece en la página 48.

En el apartado de "Material y Métodos" se describen las características de los humedales seleccionados. Además, se reseñan los análisis de datos realizados: riqueza taxonómica de los humedales estudiados, índice de diversidad de Shannon-Wiener, equitatividad, porcentaje de Chironomidae e índice de Jaccard.

OBJETIVOS DEL TRABAJO

- Conocer la composición faunística de los macroinvertebrados acuáticos de los humedales del Parque Regional del Sureste.
- Determinar las particularidades existentes en las comunidades de macroinvertebrados según los tipos y características de los humedales estudiados.
- Analizar las posibles diferencias de dichas comunidades según los diversos hábitats presentes en la zona litoral de las lagunas de gravera del Parque Regional del Sureste.
- Valorar y seleccionar los humedales más interesantes del Parque para futuros trabajos.
- Evaluar la relación entre la calidad del agua y la composición de las comunidades y abundancia de los macroinvertebrados.

RESULTADOS Y CONCLUSIONES

- En este trabajo fueron halladas 9 clases, 13 órdenes, 51 familias, 64 géneros y 88 especies de macroinvertebrados del Parque Regional del Sureste de Madrid.
- Se han encontrado 51 especies que son citas nuevas para el Parque, de las cuales 8 son citas nuevas para la Comunidad de Madrid.

- Los Ephemeroptera están representados por 2 familias, 2 géneros y 3 especies. *Cloeon inscriptum* y *Cloeon schoenemundi* son citas nuevas para el Parque.
- Los Odonata están representados por 5 familias, 15 géneros y 21 especies. *Lestes dryas*, *Aeshna mixta* y *Selysiothemis nigra* son citas nuevas para el Parque.
- Los Heteroptera están representados por 8 familias, 14 géneros y 21 especies. *Corixa panzeri*, *Heliocorisa vermiculata*, *Plea minutissima minutissima* y *Gerris* (*Gerriselloides*) *lateralis* son citas nuevas para el Parque.
- Los Coleoptera están representados por 10 familias, 31 géneros y 41 especies. 40 son citas nuevas para el Parque; 8 de ellas han resultado ser citas nuevas para la Comunidad de Madrid.
- Los Trichoptera están representados por 4 familias, 2 géneros y 2 especies. *Orthotrichia angustella* y *Ecnomus deceptor* son citas nuevas para el Parque.
- Los Diptera se han identificado sólo a nivel de familia; se han encontrado representantes de 13 familias (Ceratopogonidae, Chaoboridae, Chironomidae, Culicidae, Dixidae, Dolichopodidae, Empididae, Limoniidae, Psychodidae, Stratiomyidae, Syrphidae, Tabanidae y Tipulidae).
- Los insectos dominan el conjunto de los macroinvertebrados, tanto en el número de taxones identificados (104 de los 110 taxones colectados en el Parque, es decir, 94.5 %) como cuantitativamente (69015 de los 74970 individuos, el 92%).
- Los hábitats con enea soportan la abundancia más alta de macroinvertebrados (223 individuos/0.3 m^2), seguido de los de carófitos (209 individuos/0.3 m^2), hábitats sin vegetación (206 individuos/0.3 m^2) y carrizos (160 individuos/0.3 m^2).
- La riqueza más alta de taxones se obtuvo en hábitats con vegetación de enea (70% de la riqueza total de taxones) seguido de hábitats sin vegetación, carrizo y carófitos con 67, 43 y 14% de la riqueza total de taxones respectivamente.
- Los Diptera son el orden dominante en todas las estaciones muestreadas del Parque excepto en San Antonio 5 (estación 34) y el manantial de la Boyeriza (estación 84), donde los grupos dominantes fueron, respectivamente, los Heteroptera y los Coleoptera.
- La mayor abundancia media de individuos se encontró en Soto de Las Cuevas (estación 107) (571 individuos/0.3 m^2), seguida del manantial de la Boyeriza (estación 84) y de San Martín de la Vega (estación 92) con 365 y 352 individuos/0.3 m^2, respectivamente. La menor abundancia media se encontró en San Antonio 5

(estación 34) con 49 individuos/0.3 m^2 y El Porcal 9 (estación 47) con 55 individuos/0.3 m^2.

- La riqueza de taxones obtenida fue desde 16 (14.5%) hasta 36 taxones (32.7%). La riqueza de taxones más baja se observó en las lagunas de gravera de Presa del río Henares 1 (estación 7) y Parque Tierno Galván (estación 93), mientras que la riqueza de taxones más alta se encontró en el manantial de la Boyeriza (estación 84) y en Soto de Las Cuevas (estación 107).
- Los valores del índice de diversidad de Shannon fueron muy diferentes entre las distintas estaciones del estudio. El valor más alto de 2.69 se obtuvo en el manantial de la Boyeriza (estación 84), mientras que el valor más bajo (0.96) correspondió a la laguna de gravera de Presa del río Henares 1 (estación 7).
- La equitatividad hallada fue desde 0.24 (Presa del río Henares 1; estación 7) a 0.6 (Muñoz; estación 57).
- La laguna de gravera de Presa del río Henares 1 (estación 7) tiene el porcentaje más alto de abundancia de Chironomidae (82.56%), mientras que el porcentaje más bajo, 3.84%, se obtuvo en el manantial de la Boyeriza (estación 84).
- Los hábitats sin vegetación de Soto de Las Cuevas (estación 107) tienen la mayor abundancia media de macroinvertebrados (866 individuos/0.3 m^2).
- Los valores más elevados de riqueza de taxones 36 (32.7%) y 34 (30.9%) se encontraron en los hábitats sin vegetación del manantial de la Boyeriza (estación 84) y en los hábitats con vegetación de enea en Los Frailes (estación 118), respectivamente. Los valores más bajos de 4 - 8 taxones (3.6 - 7.3%) se hallaron en los hábitats sin vegetación de El Porcal (estación 47) y San Antonio 5 (estación 34), y hábitats con vegetación de carrizo en Parque Tierno Galván (estación 93).
- Los valores más altos del índice de diversidad de Shannon (2.69 y 2.68) se obtuvieron en los hábitats sin vegetación del manantial de la Boyeriza (estación 84) y en los hábitats con vegetación de enea en Las Madres 3 (estación 51), respectivamente. Los valores más bajos (0.61 y 0.62) se obtuvieron en los hábitats con vegetación de enea en la laguna gravera de Presa del río Henares 1 (estación 7) y en Ciempozuelos 1 (estación 104), respectivamente.
- El valor más alto de equitatividad (0.69) se obtuvo en los hábitats sin vegetación de Las Madres 1 (estación 49), mientras que los valores más bajos se obtuvieron en los

hábitats con vegetación de enea en Presa del río Henares 1 (estación 7) y Ciempozuelos 1 (estación 104).

- La mayor abundancia de Chironomidae (91.5 y 91.6 %) pertenece a los hábitats con vegetación de enea en Presa del río Henares 1 (estación 7) y Ciempozuelos 1 (estación 104), respectivamente. En los hábitats sin vegetación del manantial de la Boyeriza (estación 84) se alcanzó el menor porcentaje de abundancia de Chironomidae (3.8%).
- El valor del índice de Jaccard entre Las Madres 1 (estación 49) y Las Madres 3 (estación 51) fue el más alto, mientras que el más bajo resultó de la comparación entre el manantial de la Boyeriza (estación 84) y la laguna Muñoz (estación 57).
- En Presa del río Henares 2 (estación 8) se obtuvo la mayor abundancia media de Ephemeroptera (49 individuos/0.3 m^2). *Caenis luctuosa* resultó ser la especie más abundante (2364 individuos) y frecuente (recogida en 10 estaciones) de este orden en el Parque, y parece preferir hábitats sin vegetación.
- La mayor abundancia media de Odonata (35 individuos/0.3 m^2) se obtuvo en la Presa del río Henares 2 (estación 8). La especie de este orden más abundante (678 individuos) y frecuente (recogida en todas las estaciones de este estudio) resultó ser *Ischnura* sp., que parece tener preferencia por los hábitats con vegetación de enea.
- Los Heteroptera resultaron claramente abundantes en Soto de Las Cuevas (estación 107) con 107 individuos/0.3 m^2. De este orden, *Micronecta scholtzi* fue la especie más abundante (9775 individuos) y frecuente (apareció en 14 estaciones) y parece tener una destacada preferencia por los hábitats sin vegetación.
- Los Coleoptera fueron, con mucho, más abundantes en el manantial de la Boyeriza (estación 84) (246 individuos/0.3 m^2). *Helophorus brevipalpis* resultó ser la especie más abundante del orden en el Parque (1089 individuos), mientras que *Helochares lividus* fue la más frecuente (se capturó en 7 estaciones). *Helophorus brevipalpis* fue de lejos la especie más abundante en los hábitats sin vegetación, en tanto que *Helochares lividus* apareció en hábitats con carrizo y enea.
- La presencia de Trichoptera en el Parque fue muy escasa. *Ecnomus deceptor* aparece como relativamente frecuente (se recogió en 5 estaciones) pero no es abundante en el conjunto de las áreas muestreadas.
- Los Diptera resultaron claramente abundantes en Soto de Las Cuevas (estación 107) con 386 individuos/0.3 m^2. Los Chironomidae fueron, con gran diferencia, la familia

del orden más abundante (44849 individuos) y frecuente (capturada en 17 estaciones) y se encuentra tanto en hábitats con y sin vegetación.

- De las 88 especies de insectos acuáticos recogidos en las estaciones muestreadas del Parque Regional del Sureste, 18 especies (más del 20%) se han encontrado exclusivamente en el manantial de la Boyeriza (estación 84). Esta estación ha sido el único hábitat natural de los estudiados del Parque.
- 28 especies de insectos acuáticos (un 32% del total de especies recogidas) se han encontrado exclusivamente en los humedales poco profundos del Parque (con menos de 1 m de profundidad), a saber: la laguna originada por la extracción de yesos de Rivas 1 (estación 13), el manantial de la Boyeriza (estación 84) y la pequeña laguna de gravera de Los Frailes (estación 118).

1

INTRODUCTION

1. INTRODUCTION

1.1. GENERAL INTRODUCTION

The earth's ecosystems are strongly affected by anthropogenic pressures. Humanity's use of natural resources increased from an estimated 70 % of the regenerative capacity of the global biosphere in 1961 to approximately 120 % in 1999. These increasing pressures result in destruction, fragmentation and degradation of natural habitats and a reduction of global biodiversity at unprecedented rates. This biodiversity crisis will dramatically affect human well-being (Gabriels, 2007).

The Southeast Regional Park of Madrid covers an area of about 31.550 ha (Comunidad de Madrid, 2006). It was declared by Law 6/94 as a protected area (BOCM, 1994). Usually known as Southeast Park, its main purpose is to protect this area against all kind of environmental impact. This protected area is located between the rivers Manzanares and Jarama south of Madrid. It has suffered serious degradation as a result of the urban, industrial, and agricultural activities carried on inside the region and in its surrounding area. The largest impact is intense gravel extraction activity. Designation of the area as protected park has finally leaded to prohibition of gravel extraction. An effort is being made to decrease the environmental deterioration and to regenerate the most affected areas (Domínguez and Peña, 1999; Fernández *et al.*, 2000).

One of the most significant features of the Southeast Regional Park is the huge number of gaps generated by aggregate extraction. According to Domínguez and Peña (1999), there were four main types of extractive activity in Southeast Park:

1. Hillside quarries for the eventual extraction of gypsum, usually in small fragments.
2. Hillside quarries for the extraction of several types and sizes of dry materials.
3. Gravel beds above groundwater level.

4. Gravel beds below groundwater level. These are usually extensive areas, larger than 10 hectares and less than 10 meters deep. Here groundwater springs up trough gravel beds.

Ponds, thus created, are new, peculiar ecosystems with very diverse biotopes. The legislation (Law 6/1994, June 28th) has been passed which regulates protection, restoration and management of the Park (Domínguez and Peña, 1999).

1.2. MACROINVERTEBRATES AS BIOLOGICAL INDICATORS

The contribution of freshwaters in ecological degradation is disproportionately high. Although freshwaters make up only 0.01 percent of the total volume of the world's water and approximately 0.8 percent of the total surface of the Earth, it supports at least 100 000 species out of an estimated 1.8 million, or almost 6 percent of all described specie. However, biodiversity losses are far greater in freshwaters than those in the most affected terrestrial ecosystems (Sala *et al.*, 2000; Dudgeon *et al.*, 2006; Gabriels, 2007).

Monitoring the quality of a freshwater ecosystem should not rely on physical-chemical analyses alone. Using the biological monitoring to determine the ecological effects of pollution has been preferred widely for decades. The advantages of biomonitoring versus physical or chemical monitoring are: biomonitoring reflects overall ecological integrity (i.e., physical, chemical and biological), it provides a holistic measure of environmental condition by integrating stresses over time and the public better understands living organisms as measures of a "healthy" environment (Plafkin *et al.*, 1989; Pathoumthong and Vongsombath, 2007). Biological monitoring can provide more information on the state of an ecosystem than physical-chemical monitoring alone. The biotic component of an aquatic ecosystem can be considered as the "memory" of an ecosystem, integrating a wide range of ecological effects over time, while chemical analyses only provide information on the chemical water composition at the moment of sampling (Gabriels, 2007). In essence, a physico-chemical approach provides a "snapshot" of water-quality conditions. In contrast, biological monitoring provides a "moving picture" of past and present conditions, and hence, a more spatially and temporally integrated measure of ecosystem health (Rosenberg, 1998; Carter *et al.*, 2007; Verma and Saksena, 2010).

Rosenberg and Resh (1993) and Carter *et al.*, (2007) summarized the most important characters that make macroinvertebrates particularly useful for biomonitoring (1) Being ubiquitous, they are affected by perturbations in all types of waters and habitats; (2) Large numbers of species offer a spectrum of responses to perturbations; (3) The sedentary nature of many species allows spatial analysis of disturbance effects; (4) Their long life cycles allow effects of regular or intermittent perturbations, variable concentrations, etc., to be examined temporally; (5) Qualitative sampling and analysis are well developed, and can be done using simple, inexpensive equipment; (6) Taxonomy of many groups is well known and identification keys are available; (7) Many methods of data analysis have been developed for macroinvertebrate assemblages; (8) Responses of many common species to different types of pollution have been established; (9) Macroinvertebrates are well suited to experimental studies of perturbation; (10) Biochemical and physiological measures of the response of individual organisms to perturbations are being developed.

Even though there are many advantages to using macroinvertebrates in water-quality monitoring, as with all methods of environmental assessment, using macroinvertebrates as monitors of water quality however also have its limitations (Rosenberg and Resh, 1993; Carter *et al.*, 2007), (1) Quantitative sampling requires large numbers of samples, which can be costly; (2) Factors other than water quality can affect distribution and abundance of organisms; (3) Seasonal variation may complicate interpretations or comparisons; (4) Propensity of some macroinvertebrates to drift may offset the advantage gained by the sedentary nature of many species; (5) Perhaps too many methods for analysis available; (6) Certain groups are not well known taxonomically; (7) Benthic macroinvertebrates may not be sensitive to some perturbations, such as human pathogens and trace amounts of some pollutants; (8)

Poorly established relationships between specific stressors and most commonly used metrics.

1.3. LITERATURE REVIEW

Gravel pits are one of the few wetland habitats to have increased in extent during the 20th century. Gravel pits are bodies of open water created by the excavation of sand, gravel or clay for the aggregates industry. They can provide important habitats for aquatic invertebrates, especially where marginal habitats are diverse and water quality is good.

The Southeast Regional Park comprises about 123 wetlands (Roblas and García-Avilés, 1997), and one of the most significant features of the Southeast Regional Park is the huge number of gaps generated by aggregate extraction. However, except for some studies (Montes, 1993; López *et al.*, 1995; López, 1998; López and Hernández, 2000; García-Avilés, 2002 a & b; Soler *et al.*, 2006), benthic macroinvertebrate fauna of the Southeast Regional Park is poorly known. With respect to these studies, perhaps the most prominent is that made by the Inter-University Ecology Department of the Autónoma University of Madrid (Montes, 1993). This work was aimed to study the gravel pits throughout the Community of Madrid, and within the huge number of the studied gravel pits, there are about 96 gravel pits within the Park.

López *et al.* (1995), López (1998) and López and Hernández (2000) studied the aquatic Heteroptera in 26 localities in Madrid Province. During their works they studied the aquatic Heteroptera of the gravel pit of El Campillo and captured 54 adult individuals belonging to 4 species, *Micronecta scholtzi. Sigara stagnalis, Gerris thoracicus* and *Gerris argentatus. Micronecta scholtzi*, with 50 individuals captured, dominates over the others.

Very important studies were carried out in the Park by García-Avilés (2002 a & b) and concerned with the studying of orders Odonata and Heteroptera. García-Avilés (2002a) recorded 17 species of Odonata in 23 of the 26 wetlands studied in the Southeast Regional Park. The captured species are mostly widespread species in both the Iberian Peninsula and in the western Mediterranean. The most frequent and abundant species in the park are *Ischnura elegans* and *Ischnura graellsii*, found in 14 wetlands, followed by *Platycnemis latipes* at 13 wetlands, then *Anax parthenope* and *Orthetrum cancellatum*, recorded in 11 wetlands. In contrast, species like *Coenagrion puella*, *Brachythemis leucosticta* and family Gomphidae were characterized by their restricted distribution in the Park, where they recorded in the gravel pits of Los Frailes, El Porcal 9 and San Antonio 5 respectively. Other rare species, present only in two wetlands are *Sympecma fusca* (Presa del río Henares 2 and Rivas 1), *Erythromma lindenii* (San Antonio 5 and El Campillo 1) and *Erythromma viridulum* (Camping Lagos 1 and Ciempozuelos). Concerning Heteroptera, García-Avilés (2002b) recorded 16 species of in 18 of the 19 wetlands studied in the Southeast Regional Park. The most important wetlands for its wealth of aquatic Heteroptera are the Boyeriza spring, where 6 species were recorded, and followed by the gravel pits of Rivas and Presa del río Henares 1, both with 5 species. Of the species recorded during his study, the most frequent and abundant species was *Micronecta scholtzi*, and recorded in 16 wetlands. Other widespread species in the Park are *Mesovelia vittigera*, recorded in 8 wetlands and *Anisops sardeus*, which recorded in 6 wetlands. The remaining species have a very restricted distribution within the Park, being localized in only one or two wetlands.

Soler *et al.* (2006) studied the diversity and distribution of freshwater molluscs of Madrid. Since 1983 he studied 304 localities, 18 of them are located within the Southeast Regional Park. He cited 33 species of Mollusca, of which 25 are gastropods and eight bivalves. Twenty three of these species were previously reported in this area although most of them with different names either because they are synonyms or because they were determined erroneously. The 33 species were identified from a total of 463 samples together with the specimens preserved at the National Museum of

Natural Sciences. Taxonomical data and short descriptions, as well as information about the habitats in which they were found were given for the 33 species.

2

STUDY OBJECTIVES

2. STUDY OBJECTIVES

The objectives of this study were to:

- Carry out faunistic and biocenotic studies on all groups of aquatic macroinvertebrates in different habitats and in the littoral zone of some selected wetlands in the Southeast Regional Park.
- Generate a complete faunal list for the species recorded in the Southeast Regional Park.
- Select of the most significant wetlands for future sampling.
- To evaluate the relationships between water quality and macroinvertebrate community composition and abundances.
- Evaluate the relationship between macroinvertebrate communities and vegetation cover and the type of vegetation.

3

GENERAL DESCRIPTION OF THE STUDY AREA

3. GENERAL DESCRIPTION OF THE STUDY AREA

The following summarizes the major characteristics of the Southeast Regional Park. A general description is given by Roblas and García-Avilés (1997), Himi (2001), Comunidad de Madrid (2005) and Martín Álvarez (2005), where they summarized the most relevant characteristics of the study area and those are as following:

3.1. LOCATION OF STUDY AREA

The Southeast Regional Park is situated in the southeast of the Autonomous Community of Madrid. The park is located in the valley of the rivers Manzanares and Jarama, bounded to the north by the N-II road and N-IV road to the south. The area includes part of the following 1:50.000 scale topographic sheets; 559 (Madrid), 560 (Alcalá de Henares), 582 (Getafe), 583 (Arganda), 605 (Aranjuez) (Himi, 2001) (Figure 3.1).

Sixteen municipalities are partly located within this area, and are as follows: Torrejón de Ardoz, San Fernando de Henares, Coslada, Mejorada del Campo,Velilla de San Antonio, Rivas-Vaciamadrid, Arganda del Rey, Madrid, Getafe, Pinto, San Martín de la Vega, Valdemoro, Titulcia, Ciempozuelos, Chinchón and Aranjuez (Comunidad de Madrid, 2006). The total area of these municipalities is 1543.10 km^2, but not all are included completely in the Park. In fact, only two municipalities, Velilla de San Antonio and San Martín de la Vega, have included most of its surface (99.6% and 82.4%, respectively). The rest have only a small part within the protected natural area and even Torrejón de Ardoz and Coslada, represent less than 1% of its territory. Finally, Madrid includes only 1.4 % of its surface (Fernández Sañudo *et al.,* 2008). (Table 3.1 and Figure 3.2).

Table (3.1): Surface area of the municipalities included within the Southeast Regional Park. After Fernández Sañudo *et al.* (2008).

Municipio	Area (Km²)	Area of the municipality included in the park (Km²)	Percentage of area included in the park %
Madrid	605.8	8.6	1.4
Aranjuez	189.1	7.9	4.2
Chinchón	115.9	4	3.5
San Martín de la Vega	105.9	87.3	82.4
Arganda del Rey	79.7	30.8	38.6
Getafe	78.4	23.3	29.7
Rivas-Vaciamadrid	67.4	46.5	69
Valdemoro	64.2	7.8	12.1
Pinto	62.2	25	40.1
Ciempozuelos	49.6	35.3	71.1
San Fernando de Henares	38.8	12.8	33
Torrejón de Ardoz	32.6	0.1	0.2
Mejorada del Campo	17.2	3.3	19.2
Velilla de San Antonio	14.4	14.3	99.6
Coslada	12	0.1	0.6
Titulcia	9.9	6.7	68.1

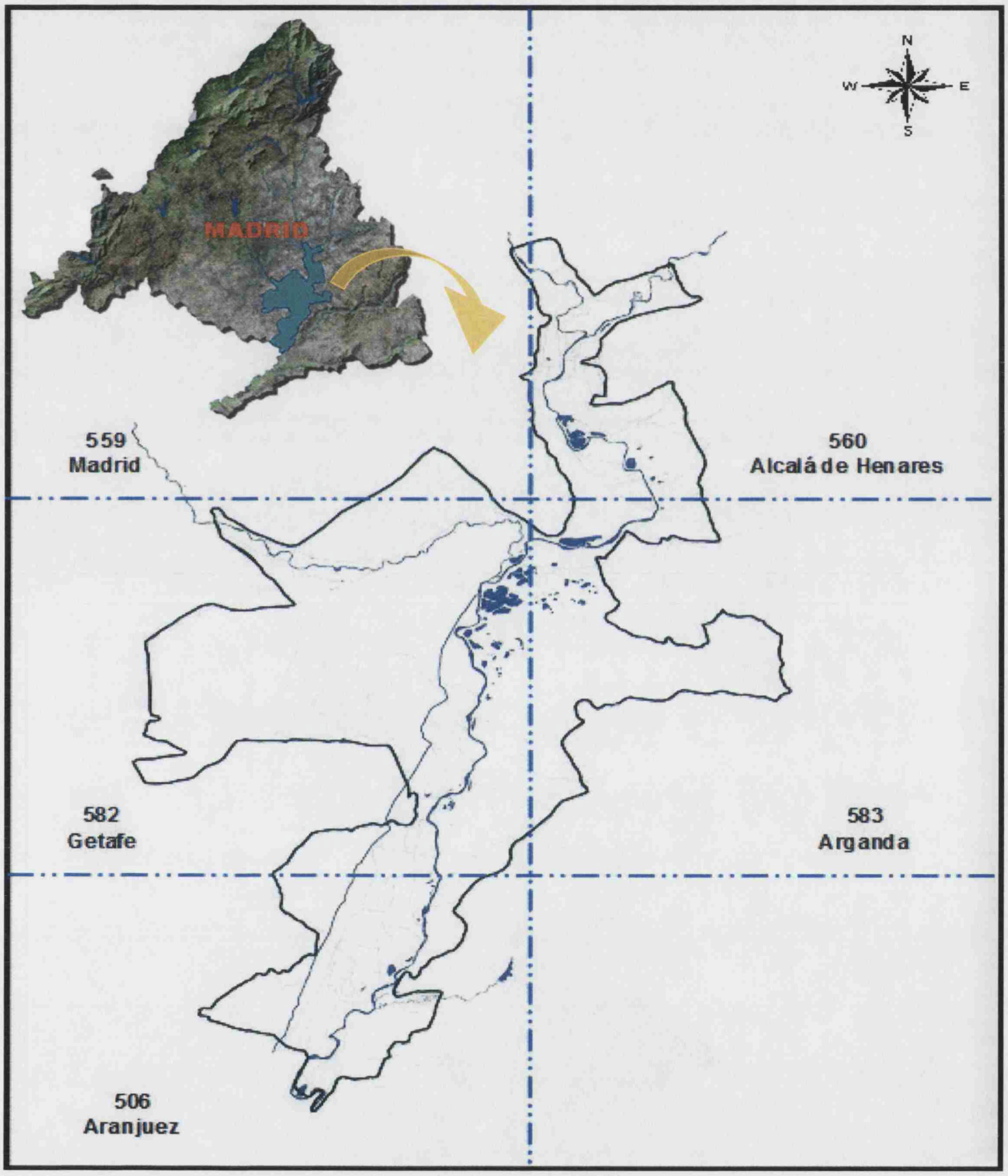


Figure (3.1): Location map of the Southeast Regional Park.

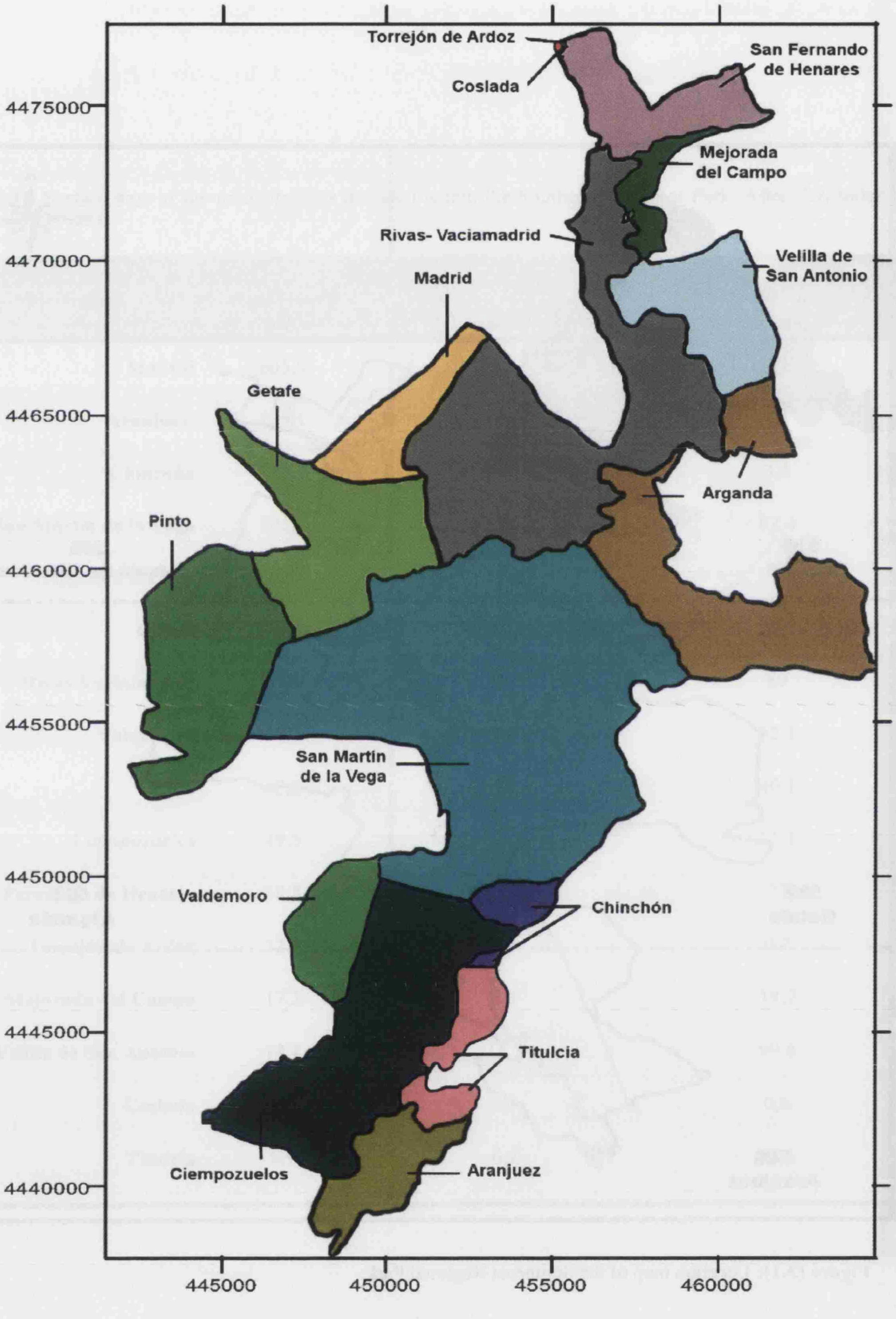


Figure (3.2): Location of the sixteen municipalities that belong to the Southeast Regional Park. Modified from Himi (2001).

3.2. ZONING OF THE SOUTHEAST REGIONAL PARK

The Law of 6/ 94 identified a number of areas involving the classification of the territory of the Park according to the distinguishing features of its biotopes, depending mainly on their degree of conservation and main uses (Comunidad de Madrid, 2005). Those zones are (Figure 3.3):

- "A" ZONE: ***Integral Reserve (Represents 3 % of total area)***

They are integral reserve areas within the territorial area, those that present ecosystems, communities or parts which by their rarity, importance or vulnerability deserve special protection. This area is divided into two, A1 and A2.

- **A1.** This area include: cliffs and cuts of Rivas and Marañosa and the gaps of the Arriadas and the North Porcal.

- **A2.** These areas include the masses of repopulation of *Pinus halepensis*, next to the cuts of La Marañosa.

- "B" ZONE: ***Nature Reserve (Represents 24.9 % of the total area)***

They are natural reserve areas those that have been little changed or where the current exploitation of natural resources has promoted the existence and development of formations, communities or natural elements worthy of protection, maintenance, restoration and development. Also there are two different areas B1 and B2.

- **B1.** This area has been included along the rivers Jarama, Henares, Manzanares and Tajuña, lakes and wetlands closer to them. Also part of the same strip of the cuts of Vallequillas where formations are developed *Quercus sp.* (Oak), limestone and gypsum scrubs and areas of olive groves and cereals of Pinto, where they settle bustard populations and other places of interest because of their value as habitat for species of high landscape value and local relevance.

- **B2.** This area includes the sites for repopulation of Casa de Gózquez, La Marañosa and Casa Eulogio; *Quercus* species included between el Pingarrón, el Vedadillo and el Carrascal de Arganda.

- "C" ZONE: ***Degraded to regenerate (Represents 9.7 % of total area)***

There are several areas that have been intensively used to suffer severe damage to their natural values, but because of the values that still harbor, the possibilities of regeneration and they are quite close in some cases integral reserve areas or natural reserves, have a strong natural vocation, requiring more effort restorer by which to recover, in a certain time, all its value. Based on their values and characteristics two areas C1 and C2 have been distinguished.

- **C1.** This area consists of gypsum scrubs of both Ciempozuelos and Rivas and *Quercus* species of San Martín de la Vega.

- **C2.** In this area, there are some zones of limestone and gypsum scrubs as well as broom.

- **"D" ZONE:** ***Orderly exploitation of natural resources (Represents 44.8 % of the total area)***

Represented by those areas in which the main activities are related to the farm, water resources, mining and forestry. Based on their characteristics, there are three different areas D1, D2 and D3.

- **D1.** This area included the pines of El Portachuelo and some spots in the south of Carrascal de Arganda.

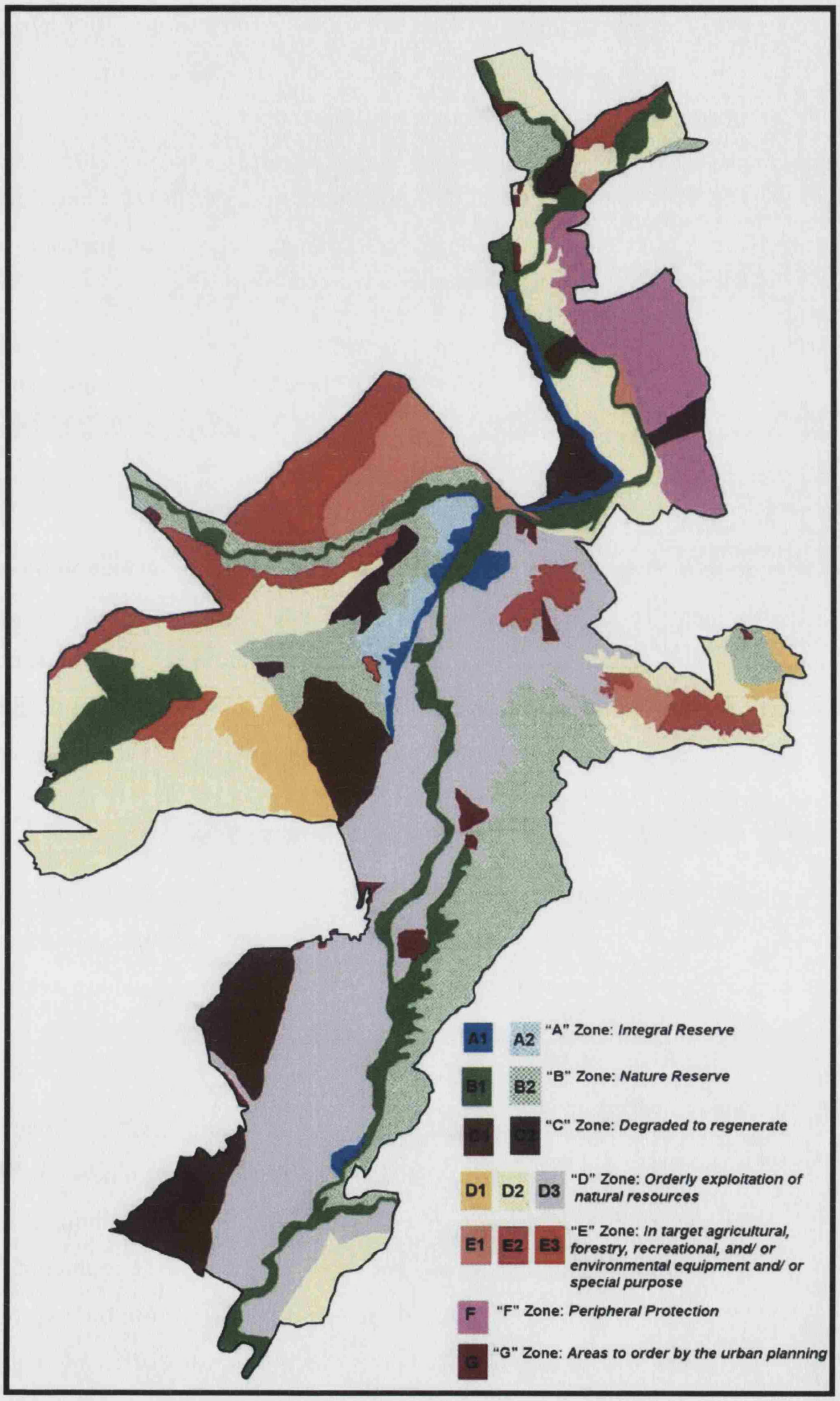


Figure (3.3): Zoning map of the Southeast Regional Park. Modified from Comunidad de Madrid (2005).

- **D2.** This area consists of land with soils greater capacity for agricultural purposes near the main rivers and moors, as well as some areas of olive groves and places of livestock and forest uses.

- **D3.** This area consists of land, smaller than those in D2, being located in the right margin of the river Jarama, below the junction of the Manzanares and Jarama rivers.

- **"E" ZONE:** ***In target agricultural, forestry, recreational, and/ or environmental equipment and/ or special purpose (Represents 11.5 % of the total area)***

They are those areas that present both a low environmental value, with places of interest, but subject to a high incidence of negative impacts and potential to accommodate agricultural infrastructure, environmental equipment and/ or special, or for recreation, leisure, educational and cultural. They should also be designed to develop a vegetative cover. Depending on their characteristics and their conservation status, there are three different areas E1, E2 and E3.

- **E1.** These areas represent areas near the confluence of the Jarama, wetlands of Velilla, as well as some places of broom and limestone and gypsum scrubs in the vicinity of Valdemingómez, along with others located in the highlands of Valdecorzas.

- **E2.** This area consists of land of lower environmental value than that is included in the E1 area. It includes the irrigated places near the Henares in the municipal district of San Fernando, the spaces adjacent to the Valdemingómez plant, a strip bordering the Park of the municipal district of Getafe and some surfaces water lamina derived from old exploitations together with gravel mining within the municipal district of Arganda to the border of San Martín de la Vega.

- **E3.** This area includes infrastructures such as garbage dumps of the Valdemingómez to Pinto and the National Factory of the Chemical Products of the Marañosa.

- "F" ZONE: ***Peripheral Protection (Represents 5.3 % of total area)***

It includes a strip-shaped area occupying almost the entire municipal of the Velilla de San Antonio, also extending west of the Mejorada del Campo, to the territorial limits defined by the Park Law, within the geomorphological group known for Jarama river terraces. The environmental characteristics of this area are conditioned by their operations causing their significant alteration.

- "G" ZONE: ***Areas to order by the urban planning (Represents 0.8 % of total area)***

New area defined by the Law 7/2003 of March 20, to modify the Law 6/199, to solve irregular urban situations.

3.3. GEOGRAPHY

Geographically, the studied area is a part of the Spanish Meseta Central "Inner Plateau". Its average altitude is about 550 m. The highest areas are located on the borders of the plains with an altitude of about 700 m, while the lowest areas correspond to the confluence of the Tajuña with the Jarama River, where the altitude is about 430 m.

3.4. GEOLOGY

Geologically the Southeast Regional Park is characterized by the presence of two main lithological domains: the Tertiary Neogene and Quaternary.

The Tertiary Neogene constituent materials: gypsum and marly-gypsum formations. Within these three units can be differentiated. The first of these, the basal evaporitic facies, which composed of gypsum with predominant marine origin, marl and clay, with thickness between 100 and 150 m, just visible from 80 to 100 m. Secondly, intermediate evaporitic facies, with a thickness from 50 to 80 m, were deposited in discordance on the previous ones, being mainly constituted by marly limestone materials (marly limestone, white marl and marly clay with intercalations of white gypsum in the region of Arganda) and newly formed minerals such as sepiolite and flint levels. Finally, Páramo limestones (up to 80 m) are formed by white, gray or grayish-blue lacustrine limestones, with thickness of between 1 and 2, may also find tuffaceous limestone and marly limestone alternation, compact marl and red sandy marl with pebbles.

The Pleistocene and Holocene Quaternary materials are the other major geological unit in the park and they are bound to the fluvial systems of the rivers Manzanares and Jarama. The facies that occur are: levels of terraces, floodplains and fluvial and colluvial fans. The materials presents are sand, gravel and silt, without clay matrix, in the case of the alluvial channel, the floodplain and the system of lower terraces; gravel, sand and silt, with sandy clay matrix in the middle terraces, and conglomerates and gravel at the higher terraces. This geological unit is of great importance in relation to the existence of water laminae in the Park, and that following the removal of materials that form for use in construction, have created a large number of wetlands, with the dominant ecosystem type be made of gravel pit ponds.

3.5. EDAPHOLOGY

There are four major soil groups in the Park:

- **Inceptisols:** The most common type in the Park and it is found in the east of Pinto and around the confluence of the Jarama and Henares rivers.

- **Aridisols:** Soils used for dryland farming in the east of Pinto and plains of the rivers, mainly in the Jarama (indicates salinity).
- **Alfisols:** Soils are potentially more productive in the areas near the Manzanares River, on the terraces of the left bank of the Jarama, in the municipality of Titulcia and in East Pinto.
- **Entisols:** They are young and poorly developed soils, on the surface of the Páramos and the vicinities of the rivers Jarama and Manzanares, as well as Culebra stream and neighbourhoods of the Marañosa.

3.6. HYDROLOGY

In the studied area there are four rivers: Henares, Manzanares and Tajuña, the three tributaries of the river Jarama (Figure 3.4). The length of Jarama River is about 194 km, only 51 km (26%) are within the Park. In the Park, the Manzanares River is considered the main and the unique tributary on the right bank of the river Jarama, while on its left bank there are Henares and Tajuña rivers. The average slope of the complete channel is 7 %, but within the park does not exceed 1.5 % (Izco, 1984; Casado and Elvira, 1984).

At the height of the municipality of San Fernando de Henares, Jarama River enters the Park for its northern, and exit at the municipality of Aranjuez (Puente Largo). In the park, Jarama River has N-S direction in much of its length, running at the same time on the chemical facies (gypsum, marl and clay). The nature of this facies plays an important role in terms of physicochemical characteristics of the waters of the river network, and this is due to the high solubility of these materials tertiary.

Among the most important elements of the fluvial ecosystems are the banks. They represent a transition zone between the aquatic environment of circulating flows, and the terrestrial environment in the vicinity of the river, receiving the hydrological influence of both when building a shared space in the cycling of water, sediment and nutrient (González del Tánago, 1998).

Henares River runs about 8 km in the Park. Before its confluence with Jarama River in San Fernando de Henares, carrying urban and industrial liquid waste, which comes from what is called the Industrial Corridor of Henares, and are highly polluting due to the abundant presence of industries chemicals, pharmaceuticals, cosmetics, ceramics, etc.

The Manzanares River runs about 24 km in the Park. In its incorporation with Jarama River, contributes a pollution load of urban origin very important due to the effect of Madrid inhabitants; on the other hand, there are industrial pollution due to Culebro stream (liquid waste of Getafe, Fuenlabrada, Pinto and Humanes), which flows into the Manzanares and already in the Southeast Regional Park.

Tajuña River has the least extension within the Park with about 3 km. In general, no appreciable specific discharges, being most of the contamination that receives from diffusion and agricultural source.

3.7. HYDROGEOLOGY

Hydro-geologically, the Southeast Regional Park is located on the limit of the aquifer systems 03.05 and 03.06; these correspond respectively to the Tertiary System of Madrid-Toledo-Cáceres and the system of “Calizas del Páramo de la Alcarria”. Both the area and the percentage that represents these systems within the Regional Park were mentioned in Table (3.2), which shows that approximately 50% of the area is represented by quaternary material, the other half represent the materials which form the two systems mentioned above.

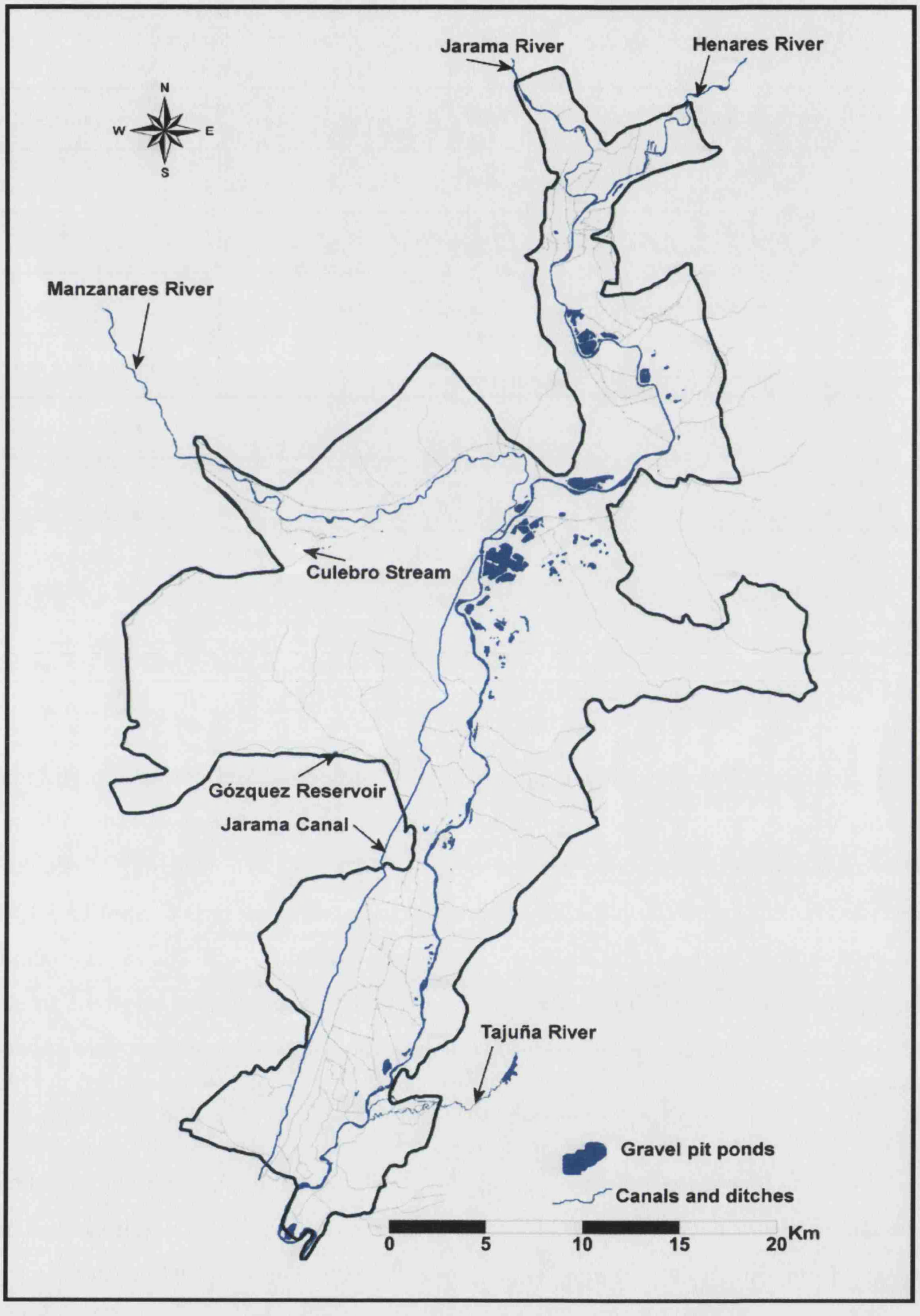


Figure (3.4): The fluvial network in the Southeast Regional Park.

Table (3.2): Distribution of the Aquifer Systems in the Southeast Regional Park. After Himi (2001).

03.05 Aquifer System		Area (km^2)	% of management area
Tertiary aquifer	Transition facies	45,5	15,6
	Chemical facies	82,6	28,5
Quaternary Aquifer		152	52
03.06 Aquifer System		Area (km^2)	% of management area
Páramo Aquifer	Detrital facies	7,6	2,6
	Calcareous facies	2,2	0,7

3.8. CLIMATOLOGY

The type of climate in the area is defined as temperate Mediterranean. The main climatic features are specified in a mean annual rainfall of between 440 and 490 mm and a mean annual evapotranspiration ranges between 700 and 776 mm, particularly noticeable in the summer months. The annual average temperature is around 13-14 ° C, with summer average of 22 to 25 ° C and in winter at around 6 ° C. The average annual temperature variation, therefore, reaches 16 to 19 ° C. The average length of frost is three months, December, January and February, while the average temperature exceeds 30 ° C in July and August.

Within this great climatic group, the territory that makes up the Southeast Regional Park presents characteristics more pronounced aridity. It is situated at the bottom of the range of average annual rainfall with 434 mm, while the average temperature is just over 14 ° C, with an average in the summer months of 24.8 ° C in July and a minimum average in the winter months of 5.5 ° C in January.

3.9. VEGETATION

The vegetation in the Southeast Regional Park is the result, as in any other territory, the influence of several factors acting in the middle. The geological history, lithology, climate, soil and human activity, whose combined effects are often cumulative, have gradually been changing and constant floristic composition of the natural environment, yet without being static, leads to their status and present form.

In the Park we can distinguish several main types of landscapes, represented by its corresponding vegetation. Thus we have:

- The cut gypsum, with its vegetation of kermes oak (*Quercus coccifera*), esparto grass (*Stipa tenacissima*) and endemic herbaceous.
- The abandoned farmlands, now colonized by communities of broom (*Retama sphaerocarpa*).
- The areas of countryside situated in river valleys and now dedicated to extensive livestock.
- Irrigated crops.
- The aquatic or water-related vegetation.

Regarding the aquatic or water-related vegetation, which is the most important in the context of our study, we can distinguish in the Park fluvial forests and littoral catenas of the gravel pits. In Mediterranean countries we can distinguish three fundamental bands of vegetation in terms of proximity to river. The first is the willow "saucedas" (*Salix* spp.), which are found near streams and play an important role in protecting margins, a natural control against floods and immobilization of the borders of the banks. Slightly away from the margins, there is a second band with poplar "choperas and alamedas", consisting mainly of white poplar (*Populus alba*) and occasionally (*Populus nigra* and *Populus* x *canadensis*) and some specimens of narrow-leafed Ash "Fresno" (*Fraxinus angustifolia*). Finally, somewhat further away from the margins, there are elms "olmedas" (*Ulmus minor*), which represent the third band.

In the gravel pit ponds, we can find the following aquatic plants:

- Reedbeds, which are formations of grasses, rooted in the banks and have their roots and a part of their stems submerged. From the inside to outside the bank can be distinguished: the bulrush (*Scirpus* spp.) at a depth of approximately 2 m or more, cattail (*Typha* spp.), located between the latter and the common reed (*Phragmites australis*), which lies at a depth not exceeding 0.3 m.

- Submerged plants. Rooted in the bottom by rhizomes and always deeper than the littoral reedbeds, but only in the most transparent lagoons. These are algae of the genus *Chara* and the phanerogam species *Najas marina* (Gil, 1991; Alvarez Cobelas *et al.*, 2000; Himi, 2001).

3.10. Preliminary considerations on the gravel pits of the Southeast Regional Park

Álvarez Cobelas *et al.* (2000) studied the physical and chemical properties of the gravel pits of the Southeast Regional Park. In his study he focused on some features of the gravel pits of the Park. Some of these features will be mentioned below.

Gravel pits are bodies of open water created by the excavation of sand, gravel or clay for the aggregates industry. The gravel pits have been developed mainly in the vicinity of large cities. In making excavations in the river valley, often reaches the phreatic level and groundwater occupies the space left by retired geological materials (Vadillo *et al.*, 1994). This type of ecosystems is not exclusive to Spain; there are many studies in Europe; for example in the Thames Valley in the United Kingdom (Abdel-Karim, 1967), in the Seine and Oise valleys near Paris (Garnier *et al.*, 1987), in the Garonne valley (Laville and Lafond-Grellety, 1969) and in the Rhine valley (Banoub, 1978).

The morphometry of the gravel pits is very characteristic and determined by the mining exploitation. Its shape is highly variable, but most are located in the river valley, surrounded by almost vertical slopes where high erosion occurs whose final destination is the water lamina. Also, the depth of the gravel pit is very variable and depends on the thickness of the interesting materials for mining companies. Thus, in the Park, there are gravel pits with more than 20 m depth (El Campillo 1) and others with less than 5 m depth (Soto de Las Cuevas). Anyway, the bathymetry of these environments is very irregular, with the deepest areas located near the border of the place where it was stopped extracting the mining material for the last time, so it is very difficult to know exactly the maximum depth and volume of each gravel pit pond without bottom maps. The procedures for extraction of gravel and sand result a lot of suspended matter which is then redistributed and sedimented in other places of the bucket depending on the predominant currents. Mining is also what determines the small width of the littoral platform: there is hardly any beach in the gravel pits and the slope of the bucket is very steep, which has important consequences for the ecological functioning of the same ponds.

The hydric balance of the gravel pits is also quite distinctive. Generally, there no surface inflows or outflows of water by visible points. Their main contribution comes from groundwater and also from fluvial waters in those very close to the rivers. Secondarily, other contributions that may be important in some of them are rain water, either directly (especially in the largest gaps) or runoff, and in others, located in agricultural areas by runoff from agricultural irrigation. Their losses are dependent on exports to the aquifer or into the nearby river, evaporation into the atmosphere and transpiration of the higher plants living in and near them.

The hydric feeding of a gravel pit by groundwater depends on the orientation of the isopiezas and the orientation of the gravel pit for those isopiezas. The gravel pits have preferential areas for recharge and others for discharge, but always determine some clear alterations in the distribution of the isopiezas which, in turn, modify the preferred directions of the local groundwater flow.

Another important aspect is the relation with the river when it is close to the gravel pit. The spatial distributions of isopiezas, as well as the orientation of the river and the gravel pit, in this case also determine whether the river loses water toward the gravel pit or if it donates it to the river. In general, both processes often occur: in some places the river supplies water and in others it receives, and the same happens to the gravel pit.

All water supply routes are often the way for the incorporation of organic matter and nutrients that cause the eutrophication of lakes. The eutrophication of gravel pits increases with respect to which other lake ecosystems may suffer, because there is no escape from them, so everything gets there or produced there, stays there. This process is fundamental to the functioning of these ecosystems, generating a positive feedback phenomenon: the more organic matter and nutrients to enter, more biomass of organisms occurs, which, to die and decompose, adding new organic matter and nutrients to the ecosystem, incorporating them into the sediment, which, under certain conditions, can return to the water, being available to living organisms during the next annual cycle.

The living organisms that inhabit the gravel pits are from many sources: the wind, the water from rivers or by the man (fish, in particular). Of course, gravel pit not born with their plant and animal communities. If the gravel pits are large and deep, the density of pelagic origin living organisms (plankton, fish) is usually quite high. In small and shallow gravel pits, the development of higher plants can be very important. It is necessary to emphasize that the decomposition of living organisms (plants and animals) in the gravel pit, increasing eutrophication of it. Therefore, the importance of each type of primary producers (phytoplankton or higher plants) depends largely on the extension and the depth of the gravel pits. The abundance of phytoplankton gives a characteristic green color to the surface of water and if there is a prevailing wind for a few hours, accumulates something like "cream" on the opposite bank to the wind direction, as often happens in the gravel pit of El Campillo 1.

The littoral belt of higher plants is of very important in the functioning of the gravel pit, because it is usually the site of greatest vegetal production and the refuge of an abundant number of animals and bacteria to be involved in the consumption and decomposition of this primary production. The decomposition of the littoral vegetation is an essential process for understanding the functioning of the gravel pits, not only at annual scale, but to more long term because it contributes to the silting of them to be added to the sediment, this decomposition contributes to the phenomenon of eutrophication and is part of what is called "internal loading" as opposed to "external load", which is comes from the aquifer from rivers or land nearby.

4

MATERIALS AND METHODS

4. MATERIALS AND METHODS

4.1. SAMPLING STATION SELECTION

For this study and because of the huge number of wetlands located in the Park, which is estimated by Roblas and García-Avilés (1997) to be 123 wetlands, it was necessary to make a preliminary selection of some of them. Based on the characterization of wetlands that had already been done by Roblas and García-Avilés (1997), we surveyed the area in June 1998, in order to select the most representative environments of the eight types of gravel pit ponds and the rest of lentic ecosystems.

Following these field surveys, and according to the characterization mentioned by Roblas and García-Avilés (1997), the following ecosystems were selected for sampling both aquatic macroinvertebrates and water (physical and chemical analysis, had already been done by Alvarez Cobelas *et al.*, 2000).

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS I":**

  Represented by the gravel pits of Henares River Dam 1, Henares River Dam 2, El Campillo 1 and San Martín de la Vega 7.

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS II":**

  Represented by the gravel pit of Los Frailes.

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS III":**

  Represented by the gravel pit of Soto de Las Cuevas.

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS IV":**

  Represented by the gravel pits of Rivas 1 and San Antonio 5.

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS V":**

Represented by the gravel pits of Camping Lagos 1, Muñoz, Villafranca and Tierno Galván Park.

- **GAPS GENERATED BY EXTRACTIVE ACTIVITIES "CLASS VI":**

  Represented by the gravel pits of El Porcal 9, Las Madres 1, Las Madres 3 and Ciempozuelos 1.

- **SPRINGS:** Represented by Boyeriza spring.
- **RESERVOIRS:** Represented by Gózquez Reservoir.

In addition to the last mentioned 18 wetlands (Figure 4.1), another 7 wetlands (El Picón, Velilla 2, El Porcal 7, Camping Lagos 2, Herrero Island, San Martín de la Vega 2 and San Martín de la Vega 6) were selected for sampling adults of Odonata. These additional wetlands may provide complementary data of interest.

Concerning classes VII and VIII of gaps generated by extractive activities were not selected representative, because it is active gravel pits in operation, so its environmental characteristics are continually being altered and do not provide suitable conditions for settlement of stable communities of aquatic macroinvertebrates. Concerning the class "Marginal Gaps", the only representative of this type that was in the park has now disappeared at the moment when becoming a new gravel pit. Finally, the class "Irrigation Rafts" was not selected by any means for being heavily contaminated or altered.

4.2. SAMPLING STATION DESCRIPTION

The most significant features of the selected wetlands based on the studies of Montes (1993), Roblas and García-Avilés (1997), BOCM (1999) and Alvarez Cobelas *et al.*, (2000) were summarized in Table (4.1). Physical and chemical characteristics are presented in Appendix 1. Photographs of some study wetlands are represented in Appendix 2. The description of each of the sampling wetlands is based mainly on Alvarez Cobelas *et al.*, (2000), and those are as following:

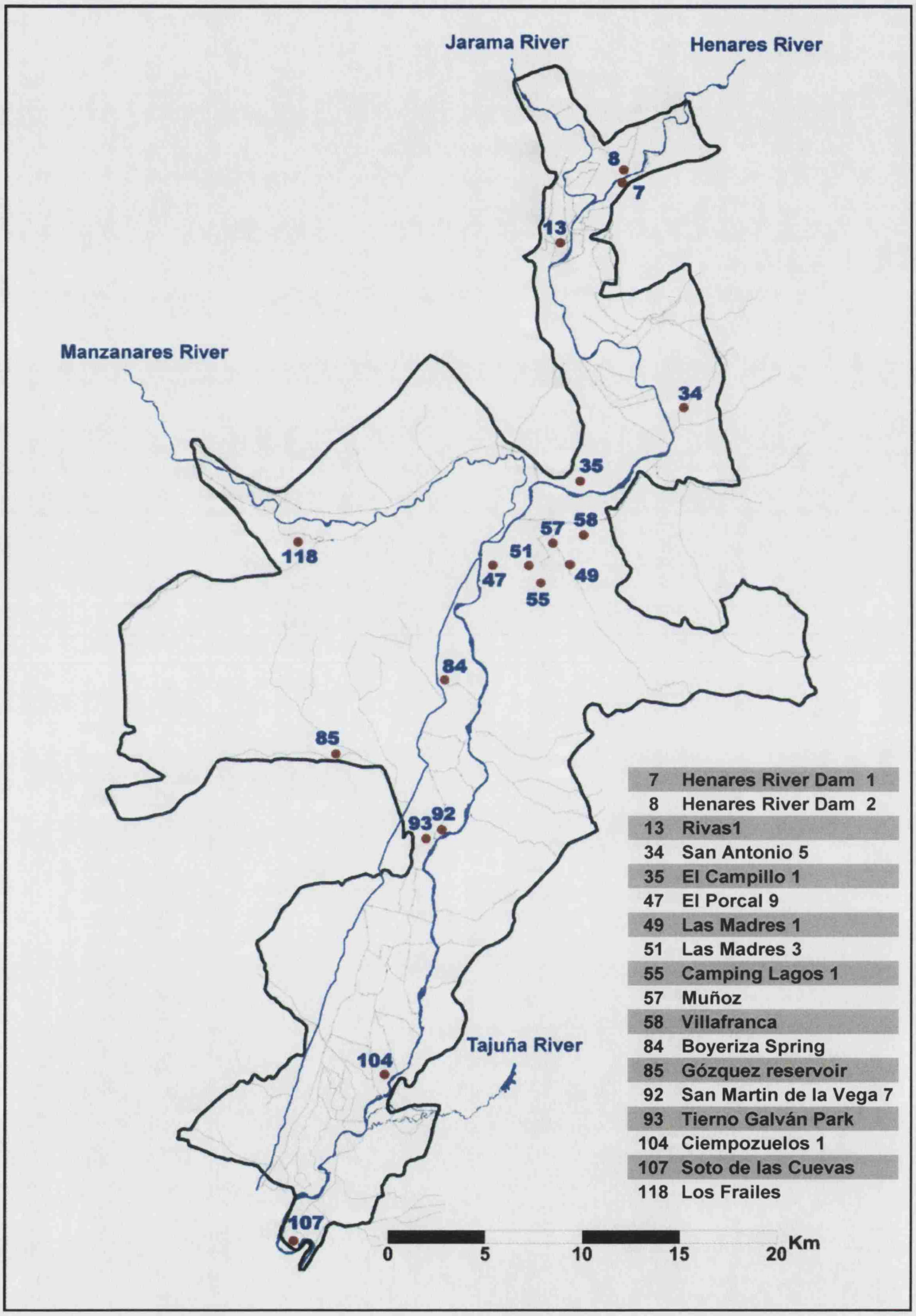


Figure (4.1): Location of the study stations of the Southeast Regional Park.

Table (4.1): The most significant features of the selected stations of the Southeast Regional Park based on the studies of Montes (1993), Roblas and García-Avilés (1997), BOCM (1999) and Alvarez Cobelas *et al.*, (2000). G: gaps generated by mining activities; NV: Non-vegetated habitat; L: Larvae; AO: Adults of Odonata.

Station	Code	Municipality	1:50,000 Map	UTM Coordinates	Altitude (m)	Drainage basin	Park zoning	Area (ha)	Max. Length (m)	Max. Width (m)	Depth (m)
Henares River Dam 1	7	Mejorada del Campo	560	30TVK583735	552	Henares	E1	4	490	130	0,75
Henares River Dam 2	8	Mejorada del Campo	560	30TVK582737	553	Henares	E1	0,26	73	68	1,5
Rivas1	13	Rivas -Vaciamadrid	560	30TVK560712	570	Jarama	B1	1	200	60	1
San Antonio 5	34	Velilla de San Antonio	560	30TVK602664	540	Jarama	F1	3	433	110	3,5
El Campillo 1	35	Rivas -Vaciamadrid	583	30TVK574636	527	Jarama	B1	32	1501	384	16
El Porcal 9	47	Rivas -Vaciamadrid	582	30TVK546610	525	Jarama	D3	120	1160	1140	10
Las Madres 1	49	Arganda	583	30TVK566613	525	Jarama	E2	3	350	123	12
Las Madres 3	51	Arganda	583	30TVK562610	525	Jarama	E2	1,5	291	223	8
Camping Lagos 1	55	Arganda	583	30TVK564607	529	Jarama	E2	8	463	353	12
Muñoz	57	Arganda	583	30TVK570617	527	Jarama	E2	5	411	156	12
Villafranca	58	Arganda	583	30TVK573618	529	Jarama	E2	3	313	170	5
Boyeriza Spring	84	San Martín de la Vega	582	30TVK523574	570	Jarama	B2	0,001	5,5	2	0,4
Gózquez Reservoir	85	San Martín de la Vega	582	30TVK494546	555	Jarama	B2	2,5	263	105	1,5
San Martín de la Vega 7	92	San Martín de la Vega	582	30TVK528521	509	Jarama	D3	0,675	216	62	1,25
Tierno Galván Park	93	San Martín de la Vega	582	30TVK522520	509	Jarama	D3	2	229	200	10
Ciempozuelos 1	104	Ciempozuelos	605	30TVK510442	500	Jarama	A1	9	534	278	12
Soto de las Cuevas	107	Aranjuez	605	30TVK479385	490	Jarama	B1	12	630	306	4
Los Frailes	118	Getafe	582	30TVK475618	555	Manzanares	E2	0,02	50	10	1
El Picón	28	Velilla de San Antonio	560	30TVK581686	542	Jarama	C2	9	650	180	_
Velilla 2	30	Velilla de San Antonio	560	30TVK592673	534	Jarama	E1	3	284	170	_
El Porcal 7	45	Rivas-Vaciamadrid	582	30TVK553619	524	Jarama	A1	8,8	440	280	_
Camping Lagos 2	56	Arganda	583	30TVK566604	528	Jarama	E2	0,466	90	78	_
Herrero Island	83	San Martín de la Vega	582	30TVK538554	515	Jarama	B1	4	647	133	_
San Martín de la Vega 2	87	San Martín de la Vega	582	30TVK534526	512	Jarama	B1	0,925	387	52	_
San Martín de la Vega 6	91	San Martín de la Vega	582	30TVK530522	509	Jarama	D3	0,564	168	46	_

Table (4.1): (Continued)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Henares River Dam 1	7	10	G. Class 1	Permanent	Hypertrophic	NV, Cattails (L+AO)	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rivas1	13	375	G. Class 4	Permanent Fluctuating	Mesotrophic	NV (L+AO)	Neogene Tertiary sediments (evaporitic facies). Gypsum and margo-gypsum of Miocene formations.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
El Campillo 1	35	20	G. Class 1	Permanent	Hypertrophic	NV, Cattails, Reeds (L+AO)	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Las Madres 1	49	2350	G. Class 6	Permanent	Oligotrophic	NV, Cattails (L+AO)	Quaternary terrace materials (gravel, sand and silt)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Camping Lagos 1	55	2050	G. Class 5	Permanent	Mesotrophic	NV, Reeds (L+AO)	Quaternary terrace materials (gravel, sand and silt)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Villafranca	58	3000	G. Class 5	Permanent	Mesotrophic	NV, Reeds (L+AO)	Quaternary terrace materials (gravel, sand and silt)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gózquez Reservoir	85	4500	Irrigation reservoir	Permanent	Eutrophic	NV, Cattails (L+AO)	Alluvium, terraces and Quaternary colluvium
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tierno Galván Park	93	400	G. Class 5	Permanent	Hypertrophic	NV, Reeds (L+AO)	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Soto de las Cuevas	107	100	G. Class 3	Permanent	Hypertrophic	NV, Cattails, Reeds (L+AO)	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
El Picón	28	41	G. Class 6	Permanent	Eutrophic	Adult odonates only	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
El Porcal 7	45	250	G. Class 6	Permanent	-	Adult odonates only	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Herrero Island	83	30	G. Class 1	Permanent	Hypertrophic	Adult odonates only	Quaternary alluvial deposits of gravel, sand, silt and clay
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
San Martín de la Vega 6	91	110	G. Class 1	Permanent	Hypertrophic	Adult odonates only	Quaternary alluvial deposits of gravel, sand, silt and clay

4.2.1. HENARES RIVER DAM 1: (STATION 7)

It is a gravel pit with a size of 4 ha. It is very near to the river channel (10 m) and has a lot of littoral vegetation. The relationship pelagic/ littoral is (10:1). The ecosystem, located in el Parque Fluvial de Mejorada del Campo, has recreational use, primarily fishing. Physical and chemical characteristics are presented in Appendix 1.

4.2.2. HENARES RIVER DAM 2: (STATION 8)

It is a small (0.26 ha) and shallow (1.5 m depth) gravel pit. It is far from the river with about 125 m, which is located on the right side of it. It has recreational use and it is near some agricultural experimental fields of the Autonomous Community of Madrid. It is surrounded by a fringe of cattail vegetation and the waters have a dark brownish appearance due to the decomposition of the cattail vegetation. The relationship pelagic/ littoral is low (6:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.3. RIVAS 1: (STATION 13)

It is an old exploitation site for gypsum, whose basin is flooded with rainwater and runoff from the western Tertiary environments to the valley of Jarama. It is relatively far from the river with about 375 m. It is not too large (1 ha) and shallow (1 m maximum depth), with rare littoral macrophytic vegetation of scattered reeds. However, in the sample of July 1998, there are two species very rare in the flora of Spain; *Riella helicophylla* and *R. notarisii* in the bottom of this station. Physical and chemical characteristics are presented in Appendix 1.

4.2.4. EL PICÓN: (STATION 28)

This gravel pit is of moderate size with about 9 ha. It is far from the Jarama River bank with about 41 m. This station was selected only for sampling adult odonates.

4.2.5. VELILLA 2: (STATION 30)

It is a gravel pit with about 3 ha and far from the Jarama River bank with about 82 m. It selected only for sampling adult odonates.

4.2.6. SAN ANTONIO 5: (STATION 34)

It is a very interesting gravel pit in the park, far from the river with about 400 m. It is not very large (3 ha), with a depth of 3.5 m. Used for fishing and has a fringe of tamarinds and cattail on the shore.

4.2.7. EL CAMPILLO 1: (STATION 35)

From the wetlands studied, it is the second largest one (32 ha), lies next to the river (20 m at its closest point), with a depth more than 16 m, with the deepest part at the center. It is very open to the wind. It has a littoral vegetation of cattail and reeds for nearly its entire border. Their relationship pelagic/ littoral is high (80:1). It has recreational use (including fishing). Physical and chemical characteristics are presented in Appendix 1.

4.2.8. EL PORCAL 7: (STATION 45)

This gravel pit is of moderate size (8.8 ha) and far from the banks of the Jarama with about 250 m. This station was selected only for sampling adult odonates.

4.2.9. EL PORCAL 9: (STATION 47)

It is the largest gravel pit in the Southeast Regional Park with about 120 ha. Their orientation has changed since the 1980s, when it was N-S (Alvarez Cobelas *et al.*, 1987), at present, is predominantly E-O direction. The maximum depth is about 8-10 m. It is very open to the wind; this effect on the physical and chemical characteristics of waters as well as the plankton distribution). It is very close to the river (40 m at its closest point), just below the confluence of the rivers Manzanares and Jarama. It has a fringe of aquatic vegetation only in the west littoral zone, closer to the river bed. The relationship pelagic/ littoral is very high (1400:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.10. LAS MADRES 1: (STATION 49)

It is a deep pond and occupies an area about 3 ha, with a littoral vegetation of reeds and cattails around its border. Their relationship pelagic/ littoral is relatively high (30:1). It has interesting plants like *Najas marina* and *Scirpus litoralis* (Gil, 1991). This basin is probably the most peculiar of all the Southeast Regional Park because it is the only meromictic lake, i.e. has layers of water that do not intermix at any time of year. This is due to the existence of a deep layer, close to the sediment, from 10 m deep, much denser than those above due to the sediment that it has in suspension. Physical and chemical characteristics are presented in Appendix 1.

4.2.11. LAS MADRES 3: (STATION 51)

Gravel pit with a size of 1.5 ha and with a depth of 8 m. It has an important fringe of littoral vegetation of cattail and reeds, making their relationship pelagic/ littoral (23:1) smaller than that in Las Mothers 1. It is not used for recreational purposes. Physical and chemical characteristics are presented in Appendix 1.

4.2.12. CAMPING LAGOS 1: (STATION 55)

This gravel pit is of moderate size (8 ha) and relatively deep (about 12 m), located in a depression resulting from mining. As the name implies, used for recreational purposes. Probably, is located in an area that was once agricultural. It is far from the river bed with about 2050 m. It has littoral emergent macrophytes around its border, as well as charophytes (*Chara vulgaris* y *Chara hispida*) and higher submerged plants (*Potamogeton pectinatus*). Their relationship pelagic/ littoral is relatively high (43:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.13. CAMPING LAGOS 2: (STATION 56)

It is a gravel pit with about 0.466 ha and far from the banks of the Jarama with about 2260 m. This station was selected only for sampling adult odonates.

4.2.14. MUÑOZ: (STATION 57)

It is of a medium size (5 ha) and relatively deep (12 m depth). It is far from the river channel with about 2875 m. It present in an old agricultural area has been used over time as a place of fun for water bikers. It has a narrow littoral strip of macrophytes around its border, as well as submerged charophytes (*Tolypella glomerata* and *Chara vulgaris*). The relationship pelagic/ littoral is high (36:1). It is open to the public and has a dirty border due to the residues of food, beverages and plastics. Physical and chemical characteristics are presented in Appendix 1.

4.2.15. VILLAFRANCA: (STATION 58)

Gravel pit with a size of 3 ha and with a depth of 5 m and far from the river with about 3000 m. It is a recreational area without any maintenance; consequently the abundance of remains of glass, plastic and food is remarkable. It has a fringe of littoral vegetation of reeds and cattails mixed with a huge community of submerged charophytes (*Chara hispida*), both along the littoral zone and in its central zone. The relationship pelagic/ littoral is medium (36:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.16. ISLA DEL HERRERO: (STATION 83)

It is a gravel pit with about 4 ha and far from the banks of the Jarama with about 30 meters. This station was selected only for sampling adult odonates.

4.2.17. BOYERIZA SPRING: (STATION 84)

It is a small natural spring (0.001 ha), consists of well-vegetated small buckets. It has high biomass of benthic algae and far from the Jarama River with about 1875 m. Physical and chemical characteristics are presented in Appendix 1.

4.2.18. GÓZQUEZ RESERVOIR: (STATION 85)

It is a small reservoir located in an agricultural area. It is of little depth (1.5 m) and far from the Jarama River with about 4500 m and fed by a spring. It fringed with littoral vegetation of cattails around its border. The relationship pelagic/ littoral is low (1.5:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.19. SAN MARTÍN DE LA VEGA 2: (STATION 87)

It is a pit with about 0.925 ha and far from the banks of the Jarama with about 40 m. This station was selected only for sampling adult odonates.

4.2.20. SAN MARTÍN DE LA VEGA 6: (STATION 91)

It is a pit with about 0.564 ha and far from the banks of the Jarama with about 110 m. This station was selected only for sampling adult odonates.

4.2.21. SAN MARTÍN DE LA VEGA 7: (STATION 92)

It is a gravel pit with 0.67 ha and 1.25 m depth, located very close to some areas of intensive agriculture. It has a narrow strip of cattail around its border. The relationship pelagic/ littoral zone is medium (25:1). The water is dark (due to the decomposition of cattail) and very turbid. Physical and chemical characteristics are presented in Appendix 1.

4.2.22. TIERNO GALVÁN PARK: (STATION 93)

It is a gravel pit with about 2 ha and 8.1 m depth, located in the Park of the same name of the town of San Martín de la Vega. It is used for recreation and has a large population of geese that help to fertilize the water with their droppings. It is far from the river bed with about 400 m. Physical and chemical characteristics are presented in Appendix 1.

4.2.23. CIEMPOZUELOS 1: (STATION 104)

It is relatively near the river (about 20 m at its closest point) and located in an agricultural area. It is large (9 ha) and it seems to have the deepest zone in its southern part. It has a well developed fringe of cattail and reeds. The relationship pelagic/ littoral is high (400:1). Not used for recreation. Physical and chemical characteristics are presented in Appendix 1.

4.2.24. SOTO DE LAS CUEVAS: (STATION 107)

It is a gravel pit with 12 ha and 4 m depth, far from the banks of the Jarama with about 100 m. It has a narrow littoral strip of cattail and reeds alternating with some intrusion of cattail towards the pelagic zone. Their relationship pelagic/ littoral is high (73:1). Physical and chemical characteristics are presented in Appendix 1.

4.2.25. LOS FRAILES: (STATION 118)

This is the only gap selected in the Manzanares River valley. It is small (0.02 ha) and shallow (1 meter), with a well coverage of cattail vegetation. Their relationship pelagic/ littoral is very low (0.5:1). Physical and chemical characteristics are presented in Appendix 1.

4.3. MACROINVERTEBRATE SAMPLING

Primary, there have been several field prospecting trips to the studied ecosystems, in order to verify the spatial heterogeneity of them and adjust the best sampling methods suitable to their characteristics. On this aspect, it should be noted that most of the lentic aquatic ecosystems in the Park are artificial and consist of gaps that occupy former or current holdings of gravel and sand. Thus contain gaps with a very peculiar morphometry, entirely different from that possessed natural aquatic environments, especially with regard to its banks. They have steep slopes, very short distances reaching depths of over two meters, and there are a little beach areas, which greatly restricts the area colonized by helophytic vegetation, fundamentally cattails and reeds.

4.3.1. AQUATIC MACROINVERTEBRATE SAMPLING

The littoral zone typically supports the largest and most diverse populations of invertebrates due to the diverse habitat (Like aquatic vegetation, soft sediments and woody debris). So, in this study, the macroinvertebrate collection process was only restricted to this zone.

Aquatic macroinvertebrates in the selected gaps were collected during October 1998 and February, May and July 1999. In addition, there is a preceding collection in July 1998 (in which we identified only Heteroptera, Odonata and Coleoptera) and a subsequent collection during October 2009 (in 4 representative gaps; Henares River Dam 2, Rivas1, El Campillo 1 and Las Madres 1).

The samples have been quantitative, per unit area, and were performed with a square hand- net, with 30 cm^2 and a mesh size of 250 µm. In 1 m length, the hand net stirs the substrate and vegetation strongly to a depth of several inches to dislodge any benthic macroinvertebrates, so the sampled area was 0.30 m^2. Three replicate samples were collected and processed individually at each site, where possible, for each of the vegetation types present in the gap, as well as non-vegetated habitats.

FIELD PRESERVATION: The collected aquatic macroinvertebrate samples were transferred to labeled bottles and preserved in 4% formaldehyde and transported to the laboratory for further investigation. For each collection location a label written on good paper and in pencil or alcohol proof ink was made indicating the location, sample collection date, replicate number, container number (If a single sample must be divided between two or more sample containers) and collector's name. In addition, notes about the sample and sample location made in a field notebook for future reference. Photographs of the habitat also provide useful information.

PERMANENT PRESERVATION: In the laboratory, the collected specimens were thoroughly washed by a suitable flow of tap water to remove the mud and the preservative through 4 metal sieves of 5, 1, 0.5 and 0.25 mm mesh size respectively, thus obtaining four fractions. Samples separated with the 5 and 1 mm mesh size, were then poured in a white-bottomed tray of appropriate size, and the specimens were gently separated from the mud and plant debris by using fine forceps and good visualization under binocular microscope. All specimens were stored in glass bottles in 75% ethyl alcohol as wet collections. A drop of glycerin was added to the ethyl alcohol to help keep the specimens wetted for a period in case of alcohol evaporating accidentally.

4.3.2. SAMPLING ADULTS OF ODONATA AND WATER STRIDERS

Adults of Odonata are flying insects, whereas larvae are aquatic, i.e., live inside the gaps, specifically in the bottom, along the borders between the submerged vegetation. Therefore, logically, the methods for capture adult stage are completely different from the techniques used to sampling larval stage.

Sampling of adult odonates has been qualitative; survey all areas near the gaps in different types of habitats as well as the emerged part of the riparian helophytes. For these samples we used a standard entomological net. Furthermore, we have tried to collect exuviae that had been abandoned near the gaps. In specific cases, for species of great size, good flyers and very difficult to capture, their presence was proven with the help of binoculars, which has led on several occasions to species level determination. Adults sampling has been conducted at the same dates of larval sampling. In addition, there is an additional campaign was conducted in May and June 2000. The captured specimens were preserved directly in 70% ethyl alcohol, or in ethyl acetate for subsequent dry mounting.

In the case of water striders (Gerridae), because they are flying insects spend most of their time "walking" on the water surface and due to its high mobility, the sampling was qualitative, using the same hand net used in aquatic macroinvertebrates collection.

4.3.3. AQUATIC MACROINVERTEBRATE IDENTIFICATION

All the specimens were examined and identified accurately according to all available descriptions. Primary, all the separated aquatic macroinvertebrates were identified to family level depending on Tachet *et al.*, (2000) and Puig *et al.*, (1999). Ephemeroptera was identified depending on Puig (1984). Odonata was identified to species level depending on Conci and Nielsen (1956), Carchini (1983), d'Aguilar *et al.* (1987), Heidemann and Seidenbusch (2002) and Askew (2004). Hemiptera was identified to species level depending on the studies of Poisson (1957), Tamanini (1979), Jansson (1986), Nieser and Millán (1989), Savage (1991), Baena *et al.*, (1993), Nieser *et al.* (1994), Baena (1996), Nieser (1996) and Baena (1997). Coleoptera was identified to species level depending on Franciscolo (1979), Hansen (1987), Holmen (1987) and Nilsson and Holmen (1995).

4.4. MACROINVERTEBRATE DATA ANALYSIS

Several biological indices were used to measure the difference in macroinvertebrate community structure among sites. The following is a brief explanation of each of the metrics used in this study:

TAXA RICHNESS: This metric reflects the health of the community by measuring the diversity of the aquatic assemblage (Resh *et al.,* 1995). The total number of taxa in each sample was counted and recorded. An ecologically healthy system is generally expected to support a more diverse community of fauna; therefore, this value decreases in response to increased perturbation and decreased habitat diversity quality (Plafkin *et al.*, 1989).

SHANNON-WIENER INDEX (H'): The use of diversity indices is based upon the observation that normally undisturbed environments support communities with large numbers of species having no individuals present in overwhelming abundance. If the species of a disturbed community are ranked by numerical abundance, there may be relatively few species with large numbers of individuals. Mean diversity is affected by both "richness" of species (or abundance of different species) and by the distribution of individuals among the species. High species diversity indicates a highly complex community. The most common diversity index used for water quality studies is the Shannon-Wiener (1949).

$$\textbf{Shannon's Index of Diversity } (H') = -\Sigma\, p_i \log_2 p_i$$

Where pi is the proportion of the total number of individuals made up by species i and can be found by

$$P_i = n_i / N$$

Where ni is the number of individuals of species i and N is the total number of individuals in the sample. However, values of Shannon Index are normally range from

0-4. Values greater than 3 indicated clean water, values in the range of 1-3 were characterized by moderate pollution and values less than 1 characterized heavily polluted condition (Wilhm and Dorris, 1968 and Chakrabarty and Das, 2006)

EVENNESS: Evenness is considered as the measure of equality of abundances in a community (Alatalo, 1981). Values of evenness range from 0 to 1.

$$\textbf{Evenness (J') = H' / H'}_{max}$$

Where: $H'_{max} = \log2\ S$ (S = richness or number of taxonomic groups per sample)

PERCENT CHIRONOMIDAE: This index is the percent of the composite of Chironomidae to total organisms (García-Criado and Trigal, 2005). This family of Diptera is considered to be more pollution tolerant in the aquatic environment. The value was obtained by dividing the total number of Chironomidae by the total number of individuals in the sample. This metric should increase in response to increased perturbation.

JACCARD'S INDEX: Jaccard's index is widely used in regionalization and species association analyses, although its probabilistic basis is not usually taken into account (Real, 1999). Moreover, it can be used in species conservation because it may be applied to the power function of the relationship between species and areas to determine a measure for the optimum size for natural protection reserves (Real and Vargas, 1996). Jaccard's index may be expressed in several ways. A common approach is the following:

$$\textbf{Jaccard's Index} = c/\,(a+b-c)$$

Where c is the number of taxa found in both sites; a, the number of taxa in site A; and b, the number of taxa in site B (Real and Vargas, 1996). Jaccard's similarity and cluster analyses were performed using PASW Statistics (version 17.0) software.

5

RESULTS

5.1

AQUATIC INSECTS OF THE SOUTHEAST REGIONAL PARK: AN ANNOTATED LIST OF SPECIES COLLECTED AND OBSERVED

5.1. AQUATIC INSECTS OF THE SOUTHEAST REGIONAL PARK: AN ANNOTATED LIST OF SPECIES COLLECTED AND OBSERVED

5.1.1. GENERAL INTRODUCTION

Aquatic invertebrates can be found in nearly any habitat from small temporary pods to large lakes and small springs to large rivers. Some of the more extreme habitats include highly saline waters (e.g., Great Salt Lake), pools of petroleum, sewage treament plant lagoons, and hot springs. Within a water body, aquatic invertebrates inhabit a variety of habitats. In lentic, or standing waters, aquatic invertebrates occur at the bottoms of deep lakes, along vegetated margins, and in open water. In lotic or flowing waters, aquatic organisms occur under stones or woody debris, buried in sand or sediment, and crawling or sprawling on rocks, leaf packs, and snags. The greatest diversity of aquatic invertebrates is found in medium-sized, forested streams with cobble and gravel substrates (Bouchard, 2004).

Macroinvertebrates are not a systematic unit but a diverse assemblage of taxa, grouped together based on taxonomic restrictions, size and habitat. Generally, macroinvertebrates are considered as those invertebrate animals inhabiting the aquatic environment that are large enough to be seen with the naked eye and caught with a net or retained on a sieve with a mesh size of 250 to 1000 µm and live for at least a part of their life cycle in freshwater (Rosenberg and Resh, 1993; Tachet *et al.*, 2000; Gabriels, 2007; Hauer and Resh, 2007).

Macroinvertebrates perform a variety of functions in freshwater ecosystem. They have an important influence on nutrient cycles, primary productivity, decomposition and translocation of material (Wallace and Webster, 1996; Covich *et al.*, 1999; Boonsoong and Sangpradub, 2008). Many of them are predators that control the numbers, locations, and sizes of their prey (Crowl and Covich, 1990 and 1994), supply food for both aquatic and terrestrial vertebrate consumers (e.g., fishes, turtles, and birds) (Covich *et al.,* 1999) accelerate nutrient transfer to overlying open waters of lakes (Lindegaard, 1994; Threlkeld, 1994; Covich *et al.,* 1999) as well as to adjacent riparian zones of streams (Covich *et al.,* 1996; Johnson and Covich, 1997; Wallace *et al.,* 1997). They are the most commonly used for biomonitoring in lotic habitat worldwide (Rosenberg and Resh, 1993; Bonada *et al.*, 2006; Carter *et al.*, 2007).

DIVERSITY OF FRESHWATER ANIMALS

Balian *et al.* (2008) gave a brief overview of the freshwater animal diversity. He estimated that there is about 125,531 species (plus one micrognathozoan) or approximately 126,000 freshwater animal species. The record of 126,000 species represents 9.5% of the total number of animal species recognised globally (i.e., 1,324,000 species: UNEP, 2002). The majority of the 126,000 freshwater animal species are insects (60.4%), 14.5% are vertebrates, 10% are crustaceans. Arachnids and molluscs represent 5 and 4% of the total, respectively. The remainder belong to Rotifera (1.6%), Annelida (1.4%) Nematoda (1.4%), Platyhelminthes (Turbellaria: 1%), and a suite of minor groups such as Collembola and some groups that are predominantly marine (e.g., Bryozoa, Porifera).

On a regional scale, the Palaearctic appears to be the most speciose for most taxa, except for insects and vertebrates. The record for insects is fairly similar in the Palaearctic, the Oriental and the Neotropical regions, whereas vertebrates are most diverse in the Neotropical, followed by the Afrotropical, and Oriental regions (Balian *et al.,* 2008).

Orders Diptera, Coleoptera and Trichoptera are the major representatives of freshwater insects with 43, 18 and 15%, respectively, of the total of almost 76,000 freshwater insect species. Other important taxa are Heteroptera (6%), Plecoptera (5%), Odonata (7%) and Ephemeroptera (4%). The highest diversity of freshwater insects is recorded from the Palaearctic (20%), closely followed by the Neotropical (18.5%) and the Oriental realms (18.3%) (Figure 5.1.1). The Afrotropical and Australasian regions represent 12 and 10%, respectively, of extant insect species diversity (Balian *et al.*, 2008).

Concerning the freshwater crustaceans, it estimated to be 11,990 described species, distributed over 1,533 genera. This constitutes 30% of the total known diversity of crustaceans, which is estimated at about 40,000 species (Groombridge and Jenkins, 2002). Again, the region with the highest number of species is the Palaearctic (37%). Second and third are the Oriental and Neotropical regions (both ca. 16%) (Balian *et al.*, 2008).

The ca. 5,000 species of freshwater molluscs represent 4% of the total number of freshwater animal species, and account for only about 7% of the global total of described mollusc species, estimated at about 80,000 species (Groombridge and Jenkins, 2002). Eighty percent of the freshwater molluscs are gastropods, whereas 20% are bivalves. Gastropods and bivalves attain their highest diversity in the Palaearctic and Nearctic regions, respectively. However, the bivalve Unionidae family, of great economic importance, is most diverse in the Oriental region (Balian *et al.*, 2008).

The most speciose amongst the "minor" invertebrate phyla are Rotifera (1,948 species), Nematoda (1,808 species), Annelidae (1,761 species) and Turbellaria (Platyhelminthes: 1,297 species). Gastrotricha, Nematomorpha and Porifera are less species rich in freshwater habitats (200–300 sp.), although they are very successful in marine environments. The same holds for Bryozoa and Tardigrada (60–80 species). The least diverse groups in freshwater are Nemertea (22 species) and Cnidaria (18 species). Rotifera, Nematomorpha and Annelida-Hirudinea are mainly freshwater, but there are also generally species-rich groups like Cnidaria (7,000+ species), or Annelida-Polychaeta (9,000+ species) that are, however, poorly represented in freshwater (Figure 5.1.2) (Balian *et al.*, 2008).

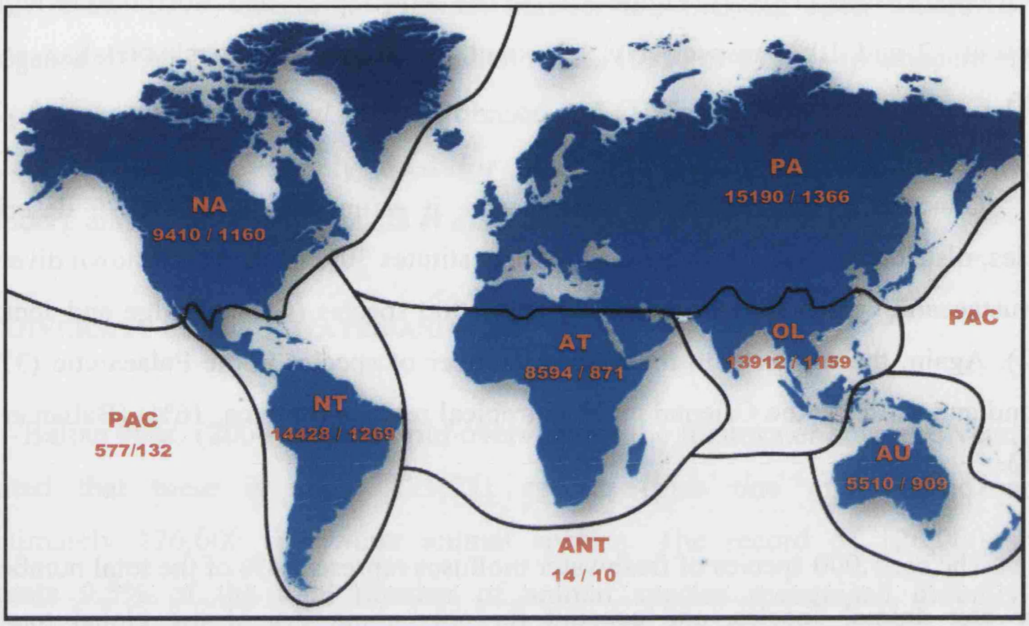


Figure (5.1.1): Distribution of total insect species and genus diversity by zoogeographic regions (number of species/ number of genera). Numbers do not include some dipteran families (i.e. Tabanidae). PA: Palaearctic; NA: Nearctic; NT: Neotropical; AT: Afrotropical; Au: Australasian; ANT: Antarctic. After Balian *et al.*, (2008).

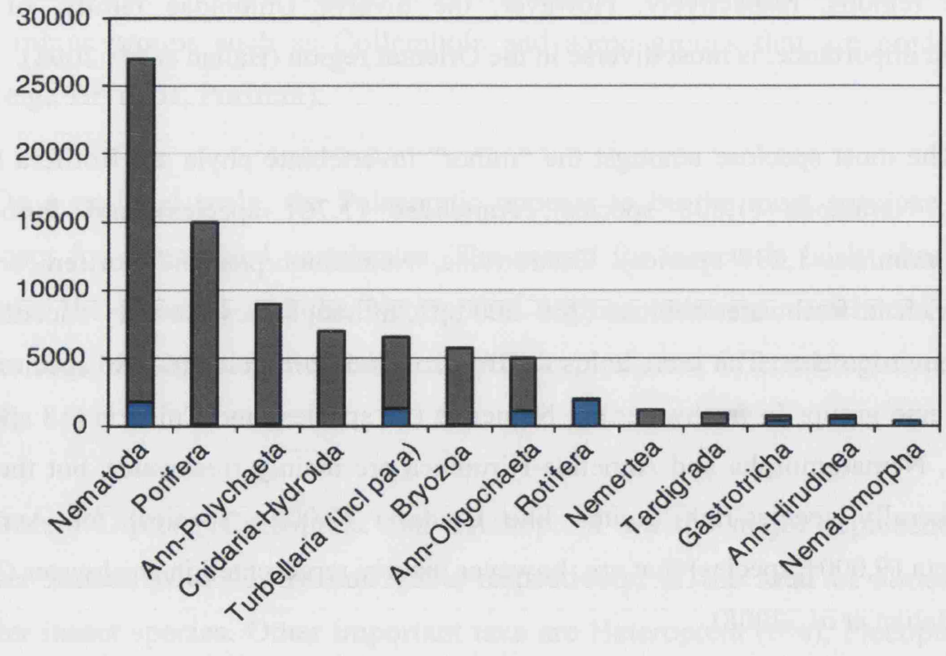


Figure (5.1.2): Species diversity in freshwater compared to total number of described species. After Balian *et al.*, (2008).

5.1.2. TAXONOMIC LIST OF AQUATIC INSECTS OF THE SOUTHEAST REGIONAL PARK

During the studied period (October 1998, February, May and July 1999, and October 2009) a total of 76700 aquatic macroinvertebrate individuals were collected in 387 replicas. In addition, there was a proceeding collection during July 1998, in which we identified Heteroptera, Odonata and Coleoptera only. Aquatic insects only were identified to genus/species level (except for Diptera which identified to family-level) and the rest of aquatic macroinvertebrates were identified to the lowest practical taxonomic level. The numeric taxonomic composition of the collected macroinvertebrates in the Southeast Regional Park was: 9 classes, 13 orders, 51 families, 64 genera and 88 species. 51 species appear to be new records for the Southeast Regional Park and 8 species appear to be new records for Madrid. The number of individuals of these orders and their respective families, genera and species is illustrated in Appendix 3, excluding the macroinvertebrate groups represented by presence/absence or missed in some months (as Hydroida, Mollusca and Ostracoda).

Concerning the taxonomic composition of aquatic insect orders identified to genus/species level, Order Coleoptera was the most diverse group and represented by 10 families, 31 genera and 31 species. Order Heteroptera was represented by 8 families, 14 genera and 21 species, Odonata (5 families, 15 genera and 21 species), Ephemeroptera (2 families, 2 genera and 3 species), and order Trichoptera was represented by 4 families, 2 genera and 2 species). Diptera was identified to family-level and was represented by 13 families. The taxonomic list of aquatic insects identified to genus/species level in the Southeast Regional Park during the study period is presented in Table (5.1.1).

Table (5.1.1): List of aquatic insects recorded in the Southeast Regional Park during the study period (July and October 1998, February, May and July 1999, and October 2009). (*): First record for the Park and (**): First record for the Park and for Madrid.

ORDER: EPHEMEROPTERA HYATT AND ARMS, 1891

Baetidae Leach, 1815

Cloeon inscriptum Bengtsson, 1914 *

Cloeon schoenemundi Bengtsson, 1936 *

Caenidae Newman, 1853

Caenis luctuosa (Burmeister, 1839)

ORDER: ODONATA FABRICIUS, 1793

Coenagrionidae Kirby, 1890

Coenagrion puella (Linnaeus, 1758)

Erythromma lindenii (Sélys, 1840)

Erythromma viridulum (Charpentier, 1840)

Enallagma cyathigerum (Charpentier, 1840)

Ischnura elegans (Vander Linden, 1820)

Ischnura graellsii (Rambur, 1842)

Ischnura pumilio (Charpentier, 1825)

Platycnemididae Tillyard, 1917

Platycnemis latipes Rambur, 1842

Lestidae Calvert, 1901

Lestes dryas Kirby, 1890 *

Lestes viridis (Vander Linden, 1825)

Sympecma fusca (Vander Linden, 1820)

Aeshnidae Rambur, 1842

Aeshna mixta Latreille, 1805 *

Anax imperator Leach, 1815

Anax parthenope (Sélys, 1839)

Libellulidae Rambur, 1842

Orthetrum cancellatum (Linnaeus, 1758)

Brachythemis leucosticta (Burmeister, 1839)

Crocothemis erythraea (Brulle, 1832)

Sympetrum fonscolombii (Sélys, 1840)

Sympetrum vulgatum (Linnaeus, 1758)

Trithemis annulata (Palisot de Beauvois, 1807)

Selysiothemis nigra (Vander Linden, 1825) *

ORDER: HETEROPTERA LATREILLE, 1810

Corixidae Leach, 1815

Corixa affinis Leach, 1817

Corixa panzeri (Fieber, 1848) *

Heliocorisa vermiculata (Puton, 1874) *

Hesperocorixa linnaei (Fieber, 1848)

Sigara (Halicorixa) selecta (Fieber, 1848)

Sigara (Vermicorixa) lateralis (Leach, 1817)

Cymatia rogenhoferi (Fieber, 1864)

Micronecta (Dichaetonecta) scholtzi (Fieber, 1860)

Naucoridae Leach, 1815

Naucoris maculatus maculatus Fabricius, 1798

Nepidae Latreille, 1802

Nepa cinerea Linnaeus, 1758

Notonectidae Latreille, 1802

Anisops sardeus sardeus Herrich-Schaeffer, 1849

Notonecta (Notonecta) maculata Fabricius, 1794

Notonecta (Notonecta) viridis Delcourt 1909

Pleidae Fieber, 1851

Plea minutissima minutissima Leach, 1817 *

Gerridae Leach, 1815

Gerris (Gerris) argentatus Schummel, 1832

Gerris (Gerris) gibbifer Schummel, 1832

Gerris (Gerris) thoracicus Schummel, 1832

Gerris (Gerriselloides) asper (Fieber, 1860)

Gerris (Gerriselloides) lateralis Schummel, 1832 *

Veliidae Brullé, 1836

Microvelia (Microvelia) pygmaea (Dufour, 1833)

Mesoveliidae Douglas and Scott, 1867

Mesovelia vittigera Horváth, 1895

ORDER: COLEOPTERA LINNAEUS, 1758

Hydroscaphidae LeConte, 1874

Hydroscapha sp. *

Gyrinidae Latreille, 1806

Gyrinus sp. *

Haliplidae Kirby, 1837

Haliplus (Neohaliplus) lineatocollis (Marsham, 1802) *

Noteridae C. G. Thomson, 1860

Noterus laevis Sturm, 1834 *

Dytiscidae Leach, 1815

Agabus (Gaurodytes) bipustulatus (Linnaeus, 1767) *

Agabus (Gaurodytes) nebulosus (Forster, 1771)

Ilybius sp. *

Colymbetes fuscus (Linnaeus, 1758) *

Rhantus (Rhantus) hispanicus Sharp, 1882 *

Rhantus (Rhantus) suturalis (MacLeay, 1825) **

Hydroglyphus geminus (Fabricius, 1792) *

Hydroglyphus signatellus (Klug, 1834) **

Graptodytes flavipes (Olivier, 1795) *

Hydroporus nigrita (Fabricius, 1792) *

Hydroporus obsoletus Aubé, 1838 **

Hydroporus pubescens (Gyllenhal, 1808) *

Oreodytes sp. *

Stictonectes lepidus (Olivier, 1795) *

Stictotarsus griseostriatus (De Geer, 1774) **

Hydrovatus cuspidatus (Kunze, 1818) **

Hygrotus (Hygrotus) inaequalis (Fabricius, 1777) **

Laccophilus hyalinus (De Geer, 1774) *

Laccophilus minutus (Linnaeus, 1758) *

Helophoridae Leach, 1815

Helophorus (Helophorus) aquaticus (Linnaeus, 1758) *

Helophorus (Rhopalohelophorus) brevipalpis Bedel, 1881 **

Helophorus (Rhopalohelophorus) flavipes Fabricius, 1792 *

Helophorus (Rhopalohelophorus) minutus Fabricius, 1775 **

Helophorus (Trichohelophorus) alternans Gené, 1836 *

Hydrophilidae Latreille, 1802

Anacaena globulus (Paykull, 1798) *

Berosus (Berosus) hispanicus Küster, 1847 *

Enochrus (Lumetus) sp. cfr. *bicolor* (Fabricius, 1792) *

Helochares (Helochares) lividus (Forster, 1771) *

Hydrobius fuscipes (Linnaeus, 1758) *

Laccobius (Dimorpholaccobius) sinuatus Motschulsky, 1849 *

Coelostoma sp. *

Hydraenidae Mulsant, 1844

Hydraena sp. *

Limnebius sp. *

Ochthebius sp. *

Scirtidae Fleming, 1821

Cyphon sp. *

Hydrocyphon sp. *

Dryopidae Billberg, 1820

Dryops luridus (Erichson, 1847) *

ORDER: TRICHOPTERA KIRBY, 1813

Hydroptilidae Stephens, 1836

Orthotrichia angustella (McLachlan, 1865) *

Ecnomidae Ulmer, 1903

Ecnomus deceptor McLachlan, 1884 *

5.1.3. LAYOUT OF DESCRIPTIONS FOR SPECIES COLLECTED AND OBSERVED IN THE SOUTHEAST REGIONAL PARK

For each aquatic insect (genus or species) recorded in the Southeast Regional Park, a descriptive card with some information was generated. The information for each genus/species was organized into the following categories:

GENERAL DISTRIBUTION: It indicates firstly the global distribution of the species, in order to later reflect its presence in the Iberian Peninsula. Also, the distribution of the species was given in Madrid whenever possible. The literature used for Ephemeroptera in this part was Puig (1984), Fauna Europaea (2004) and Buffagni *et al.*, (2009). For Odonata, Martín (1980 and 1983), d'Aguilar *et al.* (1987), Ocharan (1987), de Castro Pérez (1995), Jödicke (1996), García-Avilés (2002a), Askew (2004) and Boudot *et al.* (2009). For Heteroptera, Nieser (1978), Nieser and Montes (1984), Baena and Vázquez (1986), Jansson (1986), Nieser *et al.* (1994), Aukema and Rieger (1995), López (1998) and García-Avilés (2002b). For Coleoptera, Montes and Soler (1986), Rico *et al.* (1990), Valladares and Montes (1991), Ribera *et al.* (1998), Valladares and Ribera (1999), Jäch *et al.* (2000), Rico *et al.* (2000), Beutel *et al.* (2003), Löbl and Smetana (2003), Nilsson (2003) and Löbl and Smetana (2004). For Trichoptera, Schmid (1952), Prieto and García de Jalón (1987), González *et al.* (1992) and Vieira-Lanero (2000).

PREFERRED HABITAT: It provides information on the type of water body and habitat in which the species can be found. Always, there is a special attention to the aquatic stages. The literature used for Ephemeroptera in this section was Sowa (1980), Belfiore (1983), Varga (1998), Perán *et al.* (1999), Velasco *et al.* (2003), Monaghan *et al.* (2005) and Buffagni *et al.* (2009). For Odonata, Aguesse (1968), Carchini (1983), d'Aguilar *et al.* (1987), Ocharan (1987), Bonet-Betoret (1990), García-Avilés *et al.* (1995), García-Avilés (2002b), Heidemann and Seidenbusch (2002) and Askew (2004). For Heteroptera, Tamanini (1979), Murillo (1984), Millán (1985), Millán *et al.* (1989), Nieser *et al.* (1994), García-Avilés *et al.* (1996), López (1998), García-Avilés (2002b) and Kurzątkowska (2008). For Coleoptera, Franciscolo (1979), Cuppen (1986), Hansen (1987), Holmen (1987), Zack (1992), Nilsson and Holmen (1995), Ribera and Aguilera (1995), Alarie and Nilsson (1997), Larson (1997), Hansen (1998), McCafferty (1998), Foster (2001), Erman and Erman (2002), Jäch (2004), McCormack (2005), Sánchez-Fernández *et al.* (2007), Pakulnicka (2008), Jäch and Balke (2008), Novoa *et al.* (2009), Touaylia *et al.* (2009) and Hall and Short (2010). For Trichoptera, Vieira-Lanero (2000) and Bonada (2003).

LOCALIZATION IN THE STUDY AREA: It summarizes the results of the sampling conducted during the studied period. The obtained data, with the number of specimens studied and their distribution in the studied stations were represented in Appendix 3.

PREVIOUS RECORDS: This section lists the previous references to other authors, who have cited the species in the Park.

OBSERVATIONS: Sometimes, some additional information about the species is included. This can include information or any interesting facts about this species.

5.1.4. MAYFLIES (EPHEMEROPTERA HYATT AND ARMS, 1891)

The mayflies are relatively primitive insects, dating back to the late Carboniferous or early Permian periods, some 290 mya. It is thought that they attained their highest diversity during the Mesozoic (Barber-James *et al.*, 2008). It possess a number of traits that are thought to have been present in the earliest winged insects, such as tails and an inability to fold the wings flat over the body. All species are aquatic as larvae, and the fragile, terrestrial adults are generally short-lived, hence the allusion to this ephemeral winged stage in their scientific name (McCafferty, 1998).

The nymphal stage of mayflies is the dominant life history stage, and is always aquatic. When the nymphal stage hatches from the eggs, they are less than 1 mm length. At first they have no gills and their body shape varies according to habitat (Williams and Feltmate, 1992). The nymphs undergo a series of moults as they grow, the precise number being variable within a species, depending on external factors, such as temperature, food availability and current velocity (Brittain and Sartori, 2003). Ranges from 10 to 50 instars have been reported (Ruffieux *et al.*, 1996), giving a larval life cycle that can range from 3 weeks to 2.5 years depending on the species (Brittain, 1982). Typically, nymphs have up to seven pairs of abdominal gills, usually three caudal filaments, and mouthparts generally adapted for collector/gatherer and deposit feeding. A few species are predaceous and some are scrapers. Certain groups are burrowers, and have variously developed mandibular tusks and frontal processes to loosen the substrate, and flattened legs for digging. Burrowers usually have feathery gills, which are folded over the abdomen and used to create a current through their burrow. Mayfly nymphs colonize all types of freshwaters but are more diversified in running waters than in lakes or ponds (Barber-James *et al.*, 2008). Larvae in still waters generally have larger gills, than those in running water. This allows the larvae of each habitat to get an optimum flow of water (Harker, 1989).

Mayflies undergo hemimetabolous metamorphosis and are unique among the insects in that a fully winged terrestrial life stage, known as the subimago, precedes the sexually mature adult stage (McCafferty, 1998). The subimago covered with small water-resistant microtrichia on the wings and on the body, which help them to leave the water after moulting from the final instar nymph (Edmunds and McCafferty, 1988; Harker, 1989). After a short rest, it flies from the water to some form of shelter and shed the subimaginal cuticle within 24 to 48 hours. This additional stage enables the legs and cerci of the insect to grow longer. Longer cerci provide more stability in flight, and longer legs make it easier for the male to grasp the female in mating (Harker, 1989). Usually, mayfly adults live from a few hours to a few weeks depending on the species. Many species have male mating swarms forming at dawn or dusk. Copulation takes place in flight, and the females have various methods of oviposition and the number of eggs laid varies according to species and size of female and eggs (Barber-James *et al.*, 2008). Males die shortly after mating; females die soon after oviposition (Brittain, 1982). Length and number of life cycles per year depend largely on geographic locality and size of the species, with large burrowers in temperate climates taking over 2 years to mature, while tropical species may have several generations in a year (Barber-James *et al.*, 2008).

GLOBAL DIVERSITY OF EPHEMEROPTERA

Barber-James *et al.* (2008), studied the global diversity of Ephemeroptera in freshwater. Ephemeroptera are represented by 42 families, with a little over 3,000 described species in ca. 400 genera. Studies of their taxonomy are still in progress and numerous unknown species and genera await description, mainly in tropical areas.

Species and generic diversity is presented in Figure (5.1.3). The Holarctic Realm exhibits the highest species diversity and is also where the fauna is the best known. The faunas of the Afrotropical and Oriental Realms are probably underestimated because large areas are still ''terrae incognitae'' (e.g., Central Africa, parts of South America and Southeast Asia) (Barber-James *et al.*, 2008).

The generic diversity reflects a different pattern to species diversity when viewed by bioregion. For example, the Palearctic realm has the highest species diversity but the lowest generic diversity. As a whole, the Northern Hemisphere (Holarctic Realm) possesses fewer genera than the Southern Hemisphere. Approximately three quarters of the species and genera belong to only five families (Leptophlebiidae, Baetidae, Heptageniidae, Caenidae and Ephemerellidae). The Leptophlebiidae is the most diverse mayfly family at the generic level, while the Baetidae have more species in fewer genera. In Australasia and the Neotropics, Leptophlebiidae represent 62% and 35% of their mayfly species, respectively, while they range from 8% to 15% in other bioregions. In contrast, Baetidae are more evenly distributed among the bioregions, making up 20–25% of the species, with the exception of the Afrotropical and Oriental regions, where they represent 47% and 36%, respectively. The Heptageniidae have the third highest diversity. They are notably more diverse in the Northern Hemisphere, and contribute to 41% and 20% of the Palearctic and the Nearctic mayfly species, respectively. They constitute a minor group in other bioregions, but are absent from Australia. Although distributed worldwide, the Caenidae play a less important role in mayfly biodiversity (less than 8%) in all regions except in the Afrotropics (11%), although it should be noted that in terms of biomass they may at times exceed any other group. The Ephemerellidae, although absent from several regions, contribute to 11% of the diversity in the Nearctic, 8% in the Palaearctic and 5% in the Oriental (Barber-James *et al.*, 2008).

Twelve genera (*Baetis, Caenis, Rhithrogena, Epeorus, Cloeon, Thraulodes, Ephemera, Ecdyonurus, Pseudocloeon, Paraleptophlebia, Ameletus* and *Tricorythodes*) encompass one third of the total mayfly species richness worldwide. They have a wide range extension, being present in at least two bioregions, with the exception of two genera (*Thraulodes* and *Tricorythodes*) which are restricted to the Americas. On the other hand, 37% (149) of the genera are monospecific with a strong proportion biased towards ancient Gondwanan relicts of the South Hemisphere. They contribute 27% and 22% of the generic richness of the Neotropics and Australasia, but only 7% and 11% of the Palearctic and Nearctic, respectively (Barber-James *et al.*, 2008).

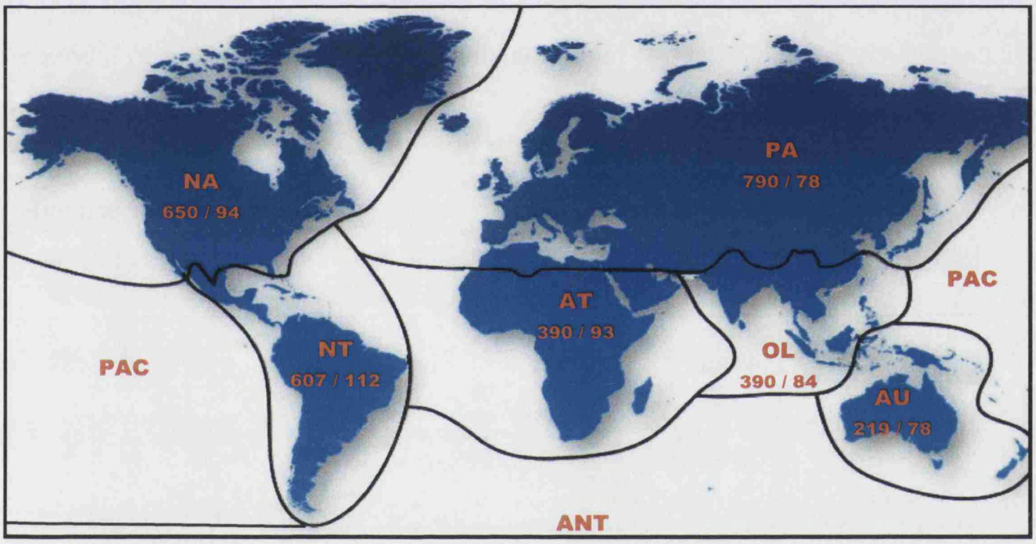


Figure (5.1.3): Ephemeroptera diversity: number of species/number of genera per realm. PA: Palaearctic; NA: Nearctic; NT: Neotropical; AT: Afrotropical; Au: Australasian (including the Pacific realm PAC); ANT: Antarctic. After Barber-James *et al.* (2008).

EPHEMEROPTERA HYATT AND ARMS, 1891

FAMILY: BAETIDAE LEACH, 1815

Cloeon inscriptum Bengtsson, 1914

GENERAL DISTRIBUTION: It is present in Europe; absent from North Africa. It is widely distributed throughout the Iberian Peninsula.

PREFERRED HABITAT: The genus *Cloeon* is common in temporary water bodies and has a wide salinity, temperature and oxygen level tolerance. Not all species possess all of these characteristics, but singly or in combination, these traits are likely to increase the success of active or passive long-distance dispersal. It feed on endolithic and epilithic algal tissues and partially tissues of living plants.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 6 wetlands, El Campillo 1, Camping Lagos I, Muñoz, Tierno Galván Park, Los Frailes and Ciempozuelos 1.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Cloeon schoenemundi Bengtsson, 1936

GENERAL DISTRIBUTION: It is distributed in Europe, absent from North Africa. It is widely distributed throughout the Iberian Peninsula.

PREFERRED HABITAT: The genus *Cloeon* is common in temporary water bodies and has a wide salinity, temperature and oxygen level tolerance. Not all species possess all of these characteristics, but singly or in combination, these traits are likely to increase the success of active or passive long-distance dispersal. It feed on endolithic and epilithic algal tissues and partially tissues of living plants.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 7 wetlands, Henares River Dam 2, Las Madres 1, Las Madres 3, Muñoz, Villafranca, Soto de Las Cuevas and El Campillo 1.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: CAENIDAE NEWMAN, 1853

Caenis luctuosa (Burmeister, 1839)

GENERAL DISTRIBUTION: It is widely distributed throughout Europe and the Iberian Peninsula, but absent from North Africa.

PREFERRED HABITAT: It occurs in both lentic and lotic habitats with slow current, and it prefers warm waters and sand substrate with abundant detritus. It is tolerant to mineralised and organically polluted waters.

LOCALIZATION IN THE STUDY AREA: This species is relatively common in the Park, where it was recorded in 10 of the 18 studied wetlands. This species was recorded in Henares River Dam 2, El Campillo 1, Las Madres 1, Las Madres 3, Camping Lagos 1, Muñoz, Tierno Galván Park, Soto de Las Cuevas, Villafranca and San Martín de la Vega 7.

PREVIOUS RECORDS: This species was recorded in the gravel pits of El Herrero Island, Ticosa 1 and Ciempozuelos 1 (Montes, 1993).

- **OTHER EPHEMEROPTERA SPECIES CITED IN THE SOUTHEAST REGIONAL PARK**

FAMILY: BAETIDAE LEACH, 1815

Cloeon simile Eaton, 1870

GENERAL DISTRIBUTION: It is distributed in Europe; absent from North Africa. It is widely distributed throughout the Iberian Peninsula.

PREFERRED HABITAT: This species prefers open water habitats, lives on organic bottom sediments and among aquatic macrophytes in various types of stagnant water in lowland and submontaneous regions.

PREVIOUS RECORDS: This species was recorded in 3 gravel pits: Ticosa 1, San Martín de la Vega 6 and San Martín de la Vega 4 (Montes, 1993).

5.1.5. DRAGONFLIES AND DAMSELFLIES (ODONATA FABRICIUS, 1793)

Dragonflies are among the most ancient of winged insects, dating back well into the Permian (Grimaldi and Engel, 2005). They are recognized by their long, slender abdomen; large globular eyes, often making up a large portion of the head; short antennae; and long wings, which have a conspicuous nodus and usually a pterostigma. They possess a unique mechanism of indirect sperm transfer: sperm are produced in the testes situated at the abdomen tip, but the secondary copulatory organs that transfer them to the female lie on the ventral side of the abdomen base. Sperm must be transferred externally to this organ before copulation. This copulatory organ is used not only to inseminate, but also to remove the sperm of the female's previous mates. Sperm competition in Odonata was first reported by Waage (1979) and stimulated numerous studies, making dragonflies one of the most studied animal groups in terms of reproductive behaviour. Another unique feature of odonates is the strongly modified labium of the larva, which can be extended at great speed to seize prey (Corbet, 1980; Kalkman *et al.*, 2008). The predacious larvae use their modified extensible labium or "mask" to capture insect, crustacean, mollusca, or oligochaeta prey. They have even been reported to consume small vertebrates. Some species burrow in the substrate and ambush prey that they detect by tactile or vibrational signals. Other species actively stalk their prey. Odonata is one of the few orders of aquatic insects whose immature stages have eyes well developed for hunting (Williams and Feltmate, 1992).

The extant dragonflies are divided into two suborders, the Zygoptera or damselflies and the Anisoptera or true dragonflies. Zygopterans have a broad head with widely separated eyes and similar fore and hind wings. Most species rest with wings closed. The larvae are slender and rely mainly on two or three caudal gills for respiration. Anisoptera are on average larger and more robust than Zygoptera. Their hind wings are distinctly broader at their base than the fore wings and in most families the eyes touch on top of the head. At rest most species spread their wings. The larvae are typically much sturdier than those of Zygoptera and lack caudal gills: oxygen is absorbed through gills in the rectum (Kalkman *et al.*, 2008).

Dragonfly larvae live in freshwater environments and only a few species tolerate brackish conditions. Both running and stagnant waters are used, while a few species are semi-terrestrial or inhabit water held in tree holes, leaf axils and other phytotelmata (Kalkman *et al.,* 2008). Odonata undergo incomplete metamorphosis and structural differences between aquatic naiads and terrestrial adults range from slight, as among some damselfly species, to substantial, as among many dragonfly species. Larval development usually involves 10 to 12 instars, but sometimes as many as 15 or as few as 8 (McCafferty, 1998). Larvae take from a few weeks to 7 years to develop (Kalkman *et al.,* 2008). The actual duration of larval development and the number of instars can vary within a species, being subject to water temperatures and food availability. Emergence generally takes place after the last larval instar has crawled from the water to cling to some object, usually in a vertical, upright position (McCafferty, 1998).

The adult stages of Odonata are generally found at or near freshwater although some species roam widely and may be found far from their breeding sites. Mating is most intricate and in some species involves well-developed courtship behavior. Before mating, the male deposits sperm in unique secondary genitalia located on the underside of his second and third abdominal segments. This is accomplished by bending the end of the abdomen, where the primary genitalia are located, under and forward to the secondary position. The male approaches the female from above and grasp her behind the head with the grasping appendages at the end of his abdomen. Adults are often seen coupled in such a manner and are said to be "in tandem". Mating takes place when the female, as she is held, loops her abdomen down and forward and engages the male's secondary genitalia (accessory genitalia). This particular coupling behavior is unique (McCafferty, 1998).

Damselflies and some dragonflies oviposit in emergent or floating vegetation or debris by puncturing the plant tissue with a well developed ovipositor. This may be accomplished above or below the waterline and is often done in tandem, the male sometimes anchoring the female during oviposition. In more advanced dragonflies, the female (sometimes flying in tandem) usually repeatedly strikes the end of the abdomen on the water surface in a rhythmic and patterned manner. A few species oviposit directly into the substrate of shallow waters (McCafferty, 1998).

GLOBAL DIVERSITY OF ODONATA

Kalkman *et al.,* (2008) studied the global diversity of the dragonflies in freshwater. In total 5,680 species of Odonata are known, 2,739 belonging to the suborder Zygoptera (19 families) and 2,941 to the suborder Anisoptera (12 families). Figure (5.1.4) show that the tropics support by far the most species of dragonflies. Besides higher diversity at the species level, the number of families is also much greater in the tropics. Twelve of the 31 families are restricted mostly to running waters within tropical forest habitats. The two largest families (Coenagrionidae and Libellulidae) are believed to be relatively recent (Rehn, 2003). Almost all ubiquitous species belong to these two families and they dominate in unshaded habitats with stagnant water (both artificial and natural). Both families include species with the greatest migratory capacity, including those with distributions spanning more than one continent and almost all species found on isolated islands.

It is estimated that between 1,000 and 1,500 species of dragonflies await description. If this is true, the actual number of extant species may be close to 7,000. The Oriental, Australasian and especially the Neotropical regions hold the highest number of undescribed species. The fauna of Africa is relatively well known and relatively depauperate. Overall the families Platystictidae, Protoneuridae, Gomphidae and Corduliidae are believed to hold relatively many undescribed species. They are typically inconspicuous odonates with small ranges, often confined to seepages or small runnels in tropical forest. The two largest families, Coenagrionidae and Libellulidae, are relatively well known, because most species are conspicuous and many favour open habitats, although in absolute numbers they still represent a large proportion of species to be described (Kalkman *et al.,* 2008).

Large parts of the Palaearctic are relatively species poor when compared with areas at the same latitude in North America. Europe for instance has only slightly more than half the number of species of Texas. Exceptions are Japan, Korea and the part of China included in the Palaearctic. The faunal diversity in these areas is at least as high as in North America and is far richer than in Europe. The large differences in diversity between different parts of the Palaearctic are largely due to the advance of glaciers during the Pleistocene ice ages, which impoverished the fauna in the western two-thirds of the Palaearctic. The dragonfly fauna of the Nearctic is richer than that of most of the Palaearctic. As in the Palaearctic, the eastern part of the Nearctic is richer than the western part, and most eastern states in the USA have larger species lists than all of Europe. It is notable that, among tropical faunas, the Afrotropical fauna is relatively poor and its composition is nearest that of the Holarctic, with few families and a large proportion of Coenagrionidae and Libellulidae (Dijkstra and Clausnitzer, 2006). This may be explained by the relatively unstable climatologically history of the continent, which favoured species capable of colonising recent or temporary habitats. The Oriental region is, together with the Neotropical region, by far the most species-rich of the eight recognised regions. The Australasian dragonfly fauna is very distinct with a strong representation of small families either largely confined to the region or showing a relict distribution. Although North and South America have numerous genera and species in common, this is primarily because the boundary between them is political rather than biogeographical. Nevertheless, the two faunas are quite distinct, with a strong faunal break at middle elevations around the Mexican Plateau, many Nearctic species in temperate habitats on that plateau, and tropical species surrounding it in the lowlands (Paulson, 1982). No species are known from Antarctica and it is unlikely that any species of dragonfly will reproduce there although it is not impossible that some species might be found as vagrants (Kalkman *et al.*, 2008).

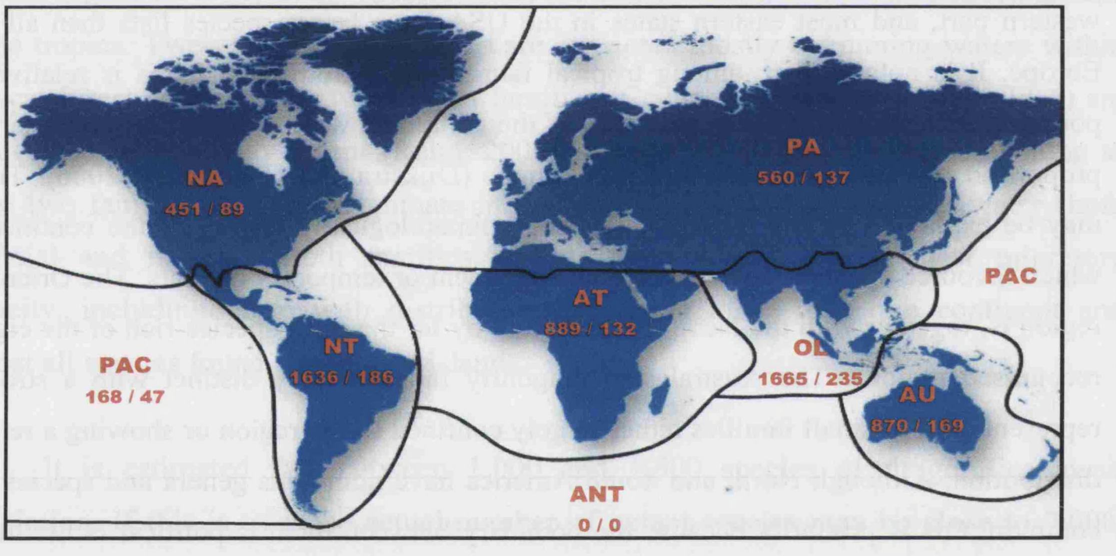


Figure (5.1.4): Odonata diversity: number of species/number of genera per realm. PA: Palaearctic; NA: Nearctic; NT: Neotropical; AT: Afrotropical; OL: Oriental; AU: Australasian; PAC: Pacific Oceanic Islands; ANT: Antarctic. After Kalkman *et al.* (2008).

ORDER: ODONATA FABRICIUS, 1793

FAMILY: COENAGRIONIDAE KIRBY, 1890

Coenagrion puella (Linnaeus, 1758)

GENERAL DISTRIBUTION: It is widely distributed throughout Europe (except the far north) and North Africa. It is common in the northern and central parts of the Iberian Peninsula, while still rare in the south. It is very localized and rare in Madrid.

PREFERRED HABITAT: An inhabitant of stagnant water bodies (lakes, ponds, wetlands, etc.) as well as slow-flowing streams, rich in vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to the gravel pit of Los Frailes and represented only by adults.

PREVIOUS RECORDS: This species was recorded in the gravel pit of Los Frailes (García-Avilés, 2002a).

Erythromma lindenii (Sélys, 1840)

GENERAL DISTRIBUTION: It is distributed in Southern and Central Europe, North Africa and Asia Minor. It is widely distributed in the Iberian Peninsula. It is common and abundant in Madrid.

PREFERRED HABITAT: It occurs mainly in pools of rivers and streams, wetlands, ponds, gravel pits and other artificial environments. It is usually found between aquatic vegetation and helophyte stems.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 3 gravel pits, San Antonio 5 (larvae), El Porcal 9 (larvae) and El Campillo 1 (Larvae and Adults).

PREVIOUS RECORDS: This species was cited in Jarama River in Rivas-Vaciamadrid (Martín, 1980 and 1983) and in the gravel pits of San Antonio 5 and El Campillo 1 (García-Avilés, 2002a).

Erythromma viridulum (Charpentier, 1840)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and the Middle East to Turkistan. It is distributed almost throughout the Iberian Peninsula. It is very localized and rare in Madrid.

PREFERRED HABITAT: This species prefers well-vegetated permanent, lentic ecosystem, both natural (lakes, ponds, etc.) and artificial (reservoirs), even in slightly brackish water.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 2 gravel pits, Camping Lagos 1 (as larvae) and Ciempozuelos 1 (as adults).

PREVIOUS RECORDS: It was recorded in Camping Lagos 1 and in Ciempozuelos 1 (García-Avilés, 2002a).

Enallagma cyathigerum (Charpentier, 1840)

GENERAL DISTRIBUTION: It is widely distributed throughout Europe, North Asia to Mongolia and North America. It is widely distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It is found mainly in stagnant water bodies, with or without vegetation.

LOCALIZATION IN THE STUDY AREA: Adults of this species were captured from 9 wetlands, Rivas1, San Antonio 5, El Campillo 1, El Porcal 9, Villafranca, Tierno Galván Park, Ciempozuelos 1, Soto de Las Cuevas and Velilla 2.

PREVIOUS RECORDS: In Jarama River in Rivas-Vaciamadrid (Martín, 1980 and 1983) and in 9 gravel pits in the Park (García-Avilés, 2002a).

Ischnura elegans (Vander Linden, 1820)

GENERAL DISTRIBUTION: It is a widespread Palaearctic species from Europe to China. In the Iberian Peninsula, it is more common from the northeast and the east to the central zone. It is very abundant and less common than the other two species of *Ischnura* recorded in Madrid.

PREFERRED HABITAT: It occurs in both stagnant water and slow-flowing streams, usually in habitats with abundant aquatic vegetation. It can tolerate slightly brackish or moderately polluted waters.

LOCALIZATION IN THE STUDY AREA: This species is the most common and abundant of all the dragonflies recorded in the Park. Adults were recorded in 14 wetlands (Henares River Dam 1, Henares River Dam 2, Velilla 2, San Antonio 5, El Campillo 1, El Porcal 7, Soto de Las Cuevas, Las Madres 3, Camping Lagos 1, Muñoz, Villafranca, Tierno Galván Park, Las Madres 1 and Gózquez Reservoir). Larvae of the genus *Ischnura* were recorded in all the studied wetlands of the Park.

PREVIOUS RECORDS: García-Avilés (2002a) collected adults of this species from 14 gravel pits in the Park.

Ischnura graellsii (Rambur, 1842)

GENERAL DISTRIBUTION: It is widely distributed throughout Europe, North Africa and the Iberian Peninsula. It is very abundant in many regions of Spain. It is considered the most common and abundant zygopterous species in Madrid.

PREFERRED HABITAT: This species prefers stagnant water and it is apparently adapted to slightly brackish water habitats.

LOCALIZATION IN THE STUDY AREA: This species is as common as the previous species of *Ischnura*, although somewhat less abundant. Adults were recorded in 14 wetlands, Henares River Dam 1, Henares River Dam 2, Rivas1, San Antonio 5, El Campillo 1, San Martín de la Vega 7, Tierno Galván Park, Ciempozuelos 1, Soto de Las Cuevas, El Picón, Velilla 2, El Porcal 7, El Herrero Island, and San Martín de la Vega 6.

PREVIOUS RECORDS: This species was cited in Jarama River in Mejorada del Campo (González del Tánago and García de Jalón, 1980; Martín, 1980 and 1983), in Jarama River in Rivas-Vaciamadrid (Martín, 1980 and 1983) and in 14 gravel pits in the Park (García-Avilés, 2002a).

Ischnura pumilio (Charpentier, 1825)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, Asia and North Africa. It is distributed throughout the Iberian Peninsula. It is a common and abundant in Madrid.

PREFERRED HABITAT: It occurs in both permanent and temporary stagnant water habitats, even in slightly brackish water. Quickly colonizes newly formed aquatic environments.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 6 gravel pits, Henares River Dam 2, Rivas1, San Antonio 5, Las Madres 1, San Martín de la Vega 7 and Soto de Las Cuevas.

PREVIOUS RECORDS: This species was recorded in Jarama River in Rivas-Vaciamadrid (Martín, 1980 and 1983) and in 6 gravel pits in the Park (García-Avilés, 2002a).

FAMILY: PLATYCNEMIDIDAE TILLYARD, 1917

Platycnemis latipes Rambur, 1842

GENERAL DISTRIBUTION: It is a Holo-Mediterranean species with Ibero-North African distribution. It is widely distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It occurs in rivers and slow-flowing streams, with aquatic and riparian vegetation.

LOCALIZATION IN THE STUDY AREA: It is a very common and abundant species in the Park, where 64 adults were captured from 13 wetlands (Henares River Dam 1, Henares River Dam 2, Soto de Las Cuevas, El Campillo 1, El Porcal 9, Las Madres 3, Muñoz, Tierno Galván Park, Ciempozuelos 1, San Antonio 5, El Picón, El Porcal 7 and Gózquez Reservoir). Larvae of the genus *Platycnemis* were recorded in 11 wetlands, Henares River Dam 2, San Antonio 5, El Campillo 1, El Porcal 9, Las Madres 1, Las Madres 3, Villafranca, Tierno Galván Park, Soto de Las Cuevas, Camping Lagos 1 and Ciempozuelos 1.

PREVIOUS RECORDS: It was recorded in Jarama River in Rivas-Vaciamadrid (Nieto and Compte, 1970; Martín, 1980 and 1983) and in 13 gravel pits in the Park (García-Avilés 2002a).

FAMILY: LESTIDAE CALVERT, 1901

Lestes dryas Kirby, 1890

GENERAL DISTRIBUTION: It is distributed in Europe, North America, Asia and North Africa. It is widely distributed throughout the Iberian Peninsula except the Mediterranean coast. It is uncommon and little abundant in Madrid.
PREFERRED HABITAT: It occurs mainly in stagnant water bodies rich in aquatic vegetation and helophytes.
LOCALIZATION IN THE STUDY AREA: Larvae of this species were recorded in Boyeriza Spring only.
PREVIOUS RECORDS: This is the first record of this species in the Park.

Lestes viridis (Vander Linden, 1825)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and Middle East. It is widely distributed in the Iberian Peninsula, being one of the most common odonates in Spain. It is very common and abundant in Madrid.
PREFERRED HABITAT: It occurs in lakes, ponds, streams and rivers with abundant arboreal vegetation or shrubs on its banks.
LOCALIZATION IN THE STUDY AREA: Larvae were recorded in Boyeriza Spring only.
PREVIOUS RECORDS: It was recorded in Jarama River in Rivas-Vaciamadrid (Martín, 1980 and 1983).

Sympecma fusca (Vander Linden, 1820)

GENERAL DISTRIBUTION: It is distributed in Europe (except its northernmost parts), North Africa, Central Asia and the Middle East. It is distributed throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in temporary, well-vegetated stagnant water habitats, even in slightly brackish water.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in Henares River Dam 2. Larvae of the genus *Sympecma* were recorded in Henares River Dam 2.

PREVIOUS RECORDS: In Rivas1 and Henares River Dam 2 (García-Avilés, 2002a).

FAMILY: AESHNIDAE RAMBUR, 1842

Aeshna mixta Latreille, 1805

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, Central Asia to China and Japan, and North Africa. It is widely distributed throughout the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in well-vegetated stagnant water habitats. Also, may be found in slow-flowing streams and rivers with abundant helophytes.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single larva recorded in Henares River Dam 2.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Anax imperator Leach, 1815

GENERAL DISTRIBUTION: It is distributed in Southern and Central Europe, in some parts of Africa and Asia Minor. It is common throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in both natural and artificial stagnant water bodies, with or without vegetation, even slightly brackish water.

LOCALIZATION IN THE STUDY AREA: Adults were recorded in 4 gravel pits, Velilla 2, Las Madres 1, Tierno Galván Park and Soto de Las Cuevas. Larvae were recorded in Henares River Dam 2 and San Martín de la Vega 7. A single exuvia was recorded in San Antonio 5.

PREVIOUS RECORDS: It was cited in Jarama River in Rivas-Vaciamadrid (Nieto and Compte, 1970), Jarama River in Mejorada del Campo (González del Tánago and García de Jalón, 1980), Las Madres 1 (Montes, 1993) and in 6 gravel pits in the Park (García-Avilés, 2002a).

Anax parthenope (Sélys, 1839)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and Asia. Their presence is more common in Southern and Eastern Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It occurs in well-vegetated lentic habitats (ponds, lakes, pools, etc.), even slightly brackish water.

LOCALIZATION IN THE STUDY AREA: It is more abundant and frequent than the previous *Anax* species. Sixteen adults were captured from 11 wetlands, Velilla 2, San Antonio 5, Las Madres 1, Camping Lagos 1, Camping Lagos 2, Muñoz, Villafranca, El Herrero Island, Tierno Galván Park, Ciempozuelos 1 and Soto de Las Cuevas. Larvae were recorded in Las Madres 3 and Soto de Las Cuevas. A single exuvia was recorded in Ciempozuelos 1.

PREVIOUS RECORDS: It was recorded in 11 wetlands in the Park (García-Avilés, 2002a).

FAMILY: LIBELLULIDAE RAMBUR, 1842

Orthetrum cancellatum (Linnaeus, 1758)

GENERAL DISTRIBUTION: It is distributed in Southern and Central Europe, North Africa and Asia to the north of India. It is distributed throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It occurs in lentic habitats (more often in artificial habitats such as gravel pits), even in slightly brackish water.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 11 wetlands, Henares River Dam 2, Rivas1, Velilla 2, San Antonio 5, Camping Lagos 1, Muñoz, Villafranca, El Herrero Island, Tierno Galván Park, Ciempozuelos 1 and Soto de Las Cuevas. In addition, larvae were recorded in 3 wetlands, El Campillo 1, Soto de Las Cuevas and Ciempozuelos 1.

PREVIOUS RECORDS: It was recorded in Jarama River in Mejorada del Campo (González del Tánago and García de Jalón, 1980) and in 11 wetlands in the Park (García-Avilés, 2002a).

Brachythemis leucosticta (Burmeister, 1839)

GENERAL DISTRIBUTION: It is distributed in Southern Europe, Africa and the Middle East to the Arabian Peninsula. It is uncommon in the Iberian Peninsula, presents in the south-western half, and seems on a clear upswing towards the northern parts. There is only a single record in Madrid by García-Avilés (2002a) in the gravel pit of El Porcal 9.

PREFERRED HABITAT: It occurs in stagnant water bodies from large lakes to small ponds. It seems to prefer non-vegetated habitats, especially around the edges.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single adult recorded in El Porcal 9.

PREVIOUS RECORDS: It was cited in El Porcal 9 by García-Avilés (2002a).

Crocothemis erythraea (Brulle, 1832)

GENERAL DISTRIBUTION: It is distributed in Southern Europe, Asia and Africa. It is distributed throughout the Iberian Peninsula, being more abundant in the southern and eastern regions. It is common and little abundant in Madrid.

PREFERRED HABITAT: It occurs mainly in stagnant water habitats, both natural and artificial, with or without vegetation, even in slightly brackish water. It may be present in slow-flowing streams rich in aquatic vegetation.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 3 wetlands, Henares River Dam 2, Camping Lagos 1 and Muñoz. Larvae were recorded in Soto de Las Cuevas and Los Frailes.

PREVIOUS RECORDS: It was recorded in Henares River Dam 2, Camping Lagos 1 and Muñoz (García-Avilés, 2002a).

Sympetrum fonscolombii (Sélys, 1840)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, Africa and Asia. It is abundant throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It occurs in the well-vegetated stagnant water bodies, natural or artificial, permanent or temporary, even in slightly brackish water.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 4 wetlands, Rivas1, San Antonio 5, Las Madres 3 and Ciempozuelos 1. Larvae were recorded in Soto de Las Cuevas and Rivas1 only.

PREVIOUS RECORDS: It was cited in Jarama River in Rivas-Vaciamadrid (Nieto and Compte, 1970), San Antonio 5 (Montes, 1993) and in 4 wetlands in the Park (García-Avilés, 2002a).

Sympetrum vulgatum (Linnaeus, 1758)

GENERAL DISTRIBUTION: It is distributed in Europe and Asia. The subspecies *Sympetrum vulgatum ibericum* Ocharan, 1985, is endemic to the Iberian Peninsula, being present in the northern half. It is very localized and rare in Madrid.

PREFERRED HABITAT: It occurs in well-vegetated stagnant water habitats.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 5 wetlands, Rivas1, Velilla 2, Las Madres 3, Tierno Galván Park and Soto de Las Cuevas.

PREVIOUS RECORDS: This species was recorded in 5 wetlands in the Park (García-Avilés, 2002a).

Trithemis annulata (Palisot de Beauvois, 1807)

GENERAL DISTRIBUTION: It is distributed in Southern Europe, West Asia and Africa. In the Iberian Peninsula, it is found mostly in the southern half, and seems on a clear upswing toward the northern parts. It is very localized and little abundant in Madrid.
PREFERRED HABITAT: It usually occurs in stagnant water habitats, and also can be found in slow-flowing streams.
LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 5 wetlands, Velilla 2, El Campillo 1, Las Madres 1, Muñoz and El Herrero Island. A single larva was recorded in Villafranca.
PREVIOUS RECORDS: It was recorded in 5 wetlands in the Park (García-Avilés, 2002a).

Selysiothemis nigra (Vander Linden, 1825)

GENERAL DISTRIBUTION: It is distributed in Southern Europe and North Africa to Central Asia. It is distributed in the south-eastern parts of the Iberian Peninsula.
PREFERRED HABITAT: It usually occurs in stagnant water bodies, permanent or temporary, even in slightly brackish water.
LOCALIZATION IN THE STUDY AREA: Larva of this species was recorded once in the gravel pit of Las Madres 3.
PREVIOUS RECORDS: This is the first record of this species in the Park.

- **OTHER ODONATA SPECIES CITED IN THE SOUTHEAST REGIONAL PARK**

FAMILY: COENAGRIONIDAE KIRBY, 1890

Ceriagrion tenellum (Villers, 1789)

GENERAL DISTRIBUTION: In Southern and Central Europe and North Africa. It is distributed throughout the Iberian Peninsula, being more frequent in the northern half.

PREFERRED HABITAT: It occurs in well-vegetated stagnant or slow-flowing water habitats.
PREVIOUS RECORDS: Nieto and Compte (1970) captured adults of this species from Jarama River.

Coenagrion caerulescens (Fonscolombe, 1838)

GENERAL DISTRIBUTION: It is distributed in Southwestern Europe and North Africa. It is uncommon in the Iberian Peninsula.
PREFERRED HABITAT: It is found in rivers and slow flowing streams.
PREVIOUS RECORDS: In Jarama River, shortly after its confluence with Henares River, in Mejorada del Campo (González del Tánago and García de Jalón, 1980).

Coenagrion mercuriale (Charpentier, 1840)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe and North Africa. In the Iberian Peninsula, it is more common in the northern half.
PREFERRED HABITAT: It occurs in well-vegetated rivers and slow-flowing streams.
PREVIOUS RECORDS: In Vaciamadrid, without indicating the type of habitat by Navás (1924) and in Rivas-Vaciamadrid, near the river Jarama by Martín (1980 and 1983).

FAMILY: LESTIDAE CALVERT, 1901

Lestes barbarus (Fabricius, 1798)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and Central Asian. It is little abundant in the Iberian Peninsula.
PREFERRED HABITAT: This species prefers stagnant freshwater or slightly brackish water habitats.
PREVIOUS RECORDS: This species was cited by Navás (1924) in Vaciamadrid, without indicating the type of habitat where it was captured.

FAMILY: GOMPHIDAE RAMBUR, 1842

Gomphus simillimus Sélys, 1840

GENERAL DISTRIBUTION: It is distributed in Southwestern Europe and North Africa. It is widely distributed in the Iberian Peninsula, but it is localized.

PREFERRED HABITAT: It occurs in rivers and rapid- flowing streams.

PREVIOUS RECORDS: It was cited by Navás (1924) in Vaciamadrid, without indicating the type of habitat.

Onychogomphus forcipatus unguiculatus (Vander Linden, 1820)

GENERAL DISTRIBUTION: It is distributed throughout Europe (except its northernmost parts), North Africa and the Middle East. It is distributed throughout the Iberian Peninsula.

PREFERRED HABITAT: It inhabits all types of slow to moderate flowing streams and rivers, and occasionally stagnant waters.

PREVIOUS RECORDS: This species was cited by Navás (1924) in Vaciamadrid, without indicating the type of habitat where it was captured.

FAMILY: LIBELLULIDAE RAMBUR, 1842

Orthetrum coerulescens (Fabricius, 1798)

GENERAL DISTRIBUTION: It is distributed in Southern and Central Europe. In the Iberian Peninsula seems to be more frequent in the northern half.

PREFERRED HABITAT: It occurs in stagnant and slow-flowing water habitats, rich in aquatic vegetation.

PREVIOUS RECORDS: This species was cited by Navás (1924) in Vaciamadrid, without indicating the type of habitat where it was captured.

5.1.6. TRUE BUGS (HETEROPTERA LATREILLE, 1810)

The aquatic and semi-aquatic Heteroptera, referred to herein subsequently as "aquatic Heteroptera", are composed of three monophyletic infraorders, the Gerromorpha, Nepomorpha, and Leptopodomorpha, with worldwide distribution. Because of their general abundance in many freshwater systems, coupled with unusual morphological specializations for exploitation of specialized microhabitats, the group has long attracted the interest of aquatic entomologists, and has a relatively mature taxonomy (Polhemus and Polhemus, 2007).

Heteroptera was decided to include as freshwater species two different categories of taxa, defined as: (1) "real aquatic species" with all or part of their lifecycle in aquatic habitats (in or on the water), and (2) "water dependent species" with a close/ specific dependence on aquatic habitats. Under these guidelines all Leptopodomorpha (the shorebugs) are deemed to be water dependent, and all Gerromorpha (water striders; which live on the water, but only rarely in the water) and all Nepomorpha (water bugs; which live mostly in the water, except for two littoral families) are deemed to be real aquatic species (Polhemus and Polhemus, 2008).

The body heteropterous insect consists of 3 distinct parts (although the head and thorax are closely adjoined in Pleidae and Helotrephidae), with mouthparts specialized for piercing and sucking (except in the Corixidae). All aquatic families are predaceous (except once again for the Corixidae, which are omnivores), with their prey consisting of any organism that can be subdued by injection of a venom consisting of toxins and proteolytic enzymes. In aquatic systems devoid of large fishes, aquatic Heteroptera may sometimes represent the top predators in the trophic chain; this is particularly true for some of the larger taxa in the families Belostomatidae and Nepidae. Members of this group also exhibit considerable variation in body size, ranging from<1 mm (the genus *Micronecta* in the Corixidae) to >110 mm (the genus *Lethocerus* in the Belostomatidae) (Polhemus and Polhemus, 2008).

Heteroptera are hemimetabolous insects, typically developing via a series of 5 nymphal instars (Polhemus and Polhemus, 2008).Growth is usually relatively fast, with each larval instar lasting about a week or two in most species. Submergent water bugs generally do not leave the water except to disperse by flight or when forced to move (e.g. by drying conditions). Few swarms or mass flights have been reported for water bugs, but individuals are often attracted by lights at night. Submergent forms generally mate in water, whereas surface and shore bugs mate in their respective habitats. Multiple matings by both the male and female are common in several groups; sometimes a male will attempt to mount another male. Stridulatory sounds in many groups and even specific wave vibration set up by some water striders can be of behavioral importance for courtship and species recognition. Eggs may be laid on underwater or exposed substrate, in earthen cells or plant tissue, or on a gelatinous pad on the back of the male (some giant water bugs). Eggs normally require from one to a few weeks for incubation (McCafferty, 1998).

The aquatic Heteropterans are a highly important group of insects. Factors of this group such as the high number of species and the unique adaptations of the insects have allowed them to become one of the most significant insect clads in many senses. Their adaptations give examples of the extremes to which insects can evolve. Across the aquatic Heteroptera as a whole the morphology of the included families and genera is extremely variable, with many demonstrating striking morphological adaptations to particular microhabitats. Aeropneustic breathing methods allow the insect to continue to utilize surface air for respiration. The simplest aeropneustic breathing method is breathing with modified cerci, joined together to form a tube, the siphon. The insect sticks this tube out of the water in order to reach air. A good example of this type of respiration is found in the water scorpions belonging to family Nepidae (McCafferty, 1998). In the Notonectidae, or backswimmers, the genus *Anisops* utilizes haemoglobin to bind or release oxygen, allowing individuals to attain neutral buoyancy and remain quietly suspended at any depth in the water column (Polhemus and Polhemus, 2008). In some Naucoridae use a plastron of ultramicroscopic hairs to create a physical gill form of respiration, obviating the need to surface for air and thus allowing them to hunt for prey beneath stones in swift running waters (Polhemus and Polhemus, 2008). The Belostomatidae, or giant water bugs, are fierce predators with powerful venoms, the largest capable of killing sizable fish, and in some cases even birds. In Corixidae, or water boatmen, air is stored primarily as a plastron ventrally on the body. The plastron's efficiency as a physical gill is increased by a rowing motion of the hind legs (a type of ventilation). Water boatmen are thus less reliant on atmospheric oxygen than some other underwater bugs, although surfacing for air replenishment may be very frequent in oxygen-poor environments (McCafferty, 1998). The above are just a few representative examples of the great ecological and morphological plasticity exhibited by this group of insects.

GLOBAL DIVERSITY OF HETEROPTERA

Polhemus and Polhemus (2008), studied the global diversity of true bugs in freshwater. They found that the aquatic and semi-aquatic Heteroptera across all three infraorders (Leptopodomorpha, Gerromorpha, and Nepomorpha) consists of 23 families, 343 genera and 4,810 species. Of these, 20 families, 326 genera and 4,656 species are considered to inhabit freshwater. In addition, more than 1,100 unequivocally diagnosed species remain to be described.

Aquatic Heteroptera occur on all continents except Antarctica, and are most numerous in the tropical regions, although there are many distinctly cold-adapted genera, particularly in the Saldidae and Corixidae. As a whole, aquatic Heteroptera are notable for utilizing an exceptionally broad range of aquatic ecosystems, from marine and intertidal to arctic and high alpine, across a global altitudinal range of 0 - 4,700 m. As such, they are excellent subjects for comparative biogeographical and ecological studies (Polhemus and Polhemus, 2008).

As shown in Figure (5.1.5) the Palearctic Region has 16 families containing 496 species. There is a high richness of cold-adapted Corixidae and Saldidae, and a low richness of Veliidae (except Veliinae), and Naucoridae. The Nearctic Region, with 16 families and 424 species, is nearly equivalent in species richness to the Palearctic. There is a high richness of Corixidae and Saldidae, which each have a number of cold-adapted genera restricted to this region, and a low richness of certain Veliidae (Veliinae). There are 18 families containing 799 species in the Afrotropical Region, with a particularly high richness of Nepidae, Aphelocheiridae, and certain Veliidae (Microveliinae, Rhagoveliinae). The Oriental Region has 17 families represented by 1,103 species, rivaling the Neotropical Region in terms of total species richness. There is a particularly high richness of Gerridae, Naucoridae and Helotrephidae, with many undescribed species in these families. The Neotropical Region, with 18 families and 1,289 species, is the world's richest in terms of described species. There is a particularly high richness of Veliidae, Belostomatidae, Naucoridae and Gelastocoridae. The Australasian Region has 17 families containing 654 species, with high richness of Gerridae, Gelastocoridae, Ochteridae, Notonectidae and certain Veliidae (Microveliinae, Rhagoveliinae). The Pacific Region has 8 families containing 37 species. No aquatic Heteroptera are currently recorded from Antarctica, although biogeographic evidence indicates that during the Early Tertiary this continent may have provided a biogeographic corridor for the interchange of certain groups (Gelastocoridae, trepobatine Gerridae) between Australia and South America (Polhemus and Polhemus, 2002; Polhemus and Polhemus, 2008).

The Corixidae and Saldidae exhibit distinctly higher species richness in the Northern Hemisphere in comparison to tropical regions. Among the Gerromorpha, there is a disproportionate richness of Veliidae in the Neotropical region, and of Gerridae in the Oriental region. Cosmopolitan groups with at least some representation in all non-polar biogeographic regions include Gerridae, Veliidae, Mesoveliidae, Hydrometridae, Hebridae, Pleidae, Belostomatidae, Nepidae, Notonectidae, Saldidae and Leptopodidae (Polhemus and Polhemus, 2008).

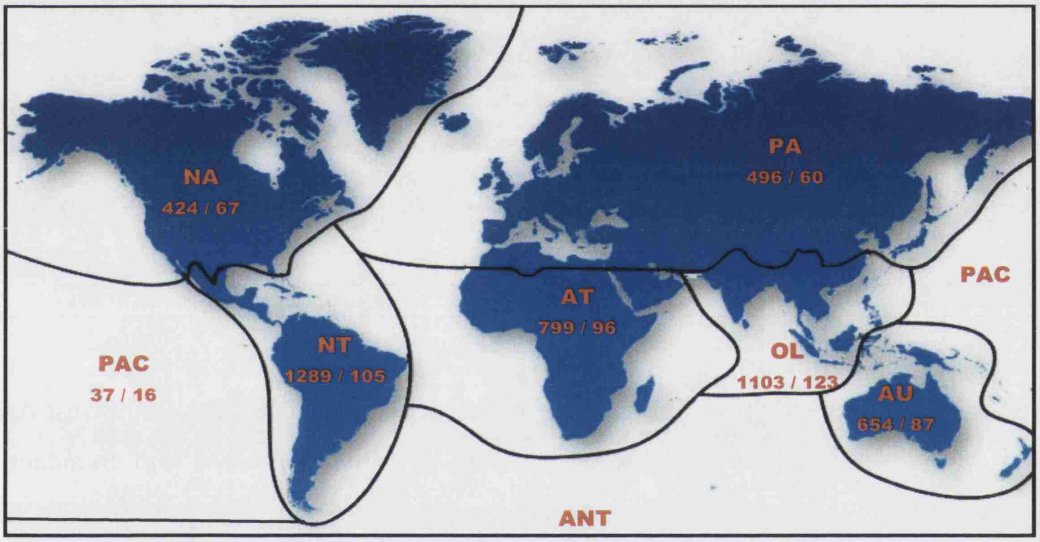


Figure (5.1.5): Aquatic Heteroptera diversity: number of species/number of genera per realm. PA: Palaearctic; NA: Nearctic; NT: Neotropical; AT: Afrotropical; OL: Oriental; AU: Australasian; PAC: Pacific Oceanic Islands; ANT: Antarctic. After Polhemus and Polhemus (2008).

ORDER: HEMIPTERA LINNAEUS, 1758

FAMILY: CORIXIDAE LEACH, 1815

Corixa affinis Leach, 1817

GENERAL DISTRIBUTION: From the British Isles and Azores through Western and Southern Europe to North Africa and the southwest of Asia. It is widely distributed throughout the Iberian Peninsula. It is common and abundant in Madrid.

PREFERRED HABITAT: It occurs mainly in stagnant water habitats with abundant aquatic vegetation, as well as rivers and slow-flowing streams.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to 2 wetlands, Rivas1 and Soto de Las Cuevas.

PREVIOUS RECORDS: It was cited in the gravel pit of Rivas 1 (García-Avilés, 2002b).

Corixa panzeri (Fieber, 1848)

GENERAL DISTRIBUTION: It is distributed in Europe, North Africa and Southwest Asia. It is distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It usually occurs in both permanent and temporary freshwater to slightly brackish lentic habitats, rich in aquatic vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single individual recorded in Soto de Las Cuevas.

PREVIOUS RECORDS: This is the first record of the species in the Park.

Heliocorisa vermiculata (Puton, 1874)

GENERAL DISTRIBUTION: It is distributed in Southern Europe, North Africa and the Middle East to India. It is mainly distributed in the southern half of the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in both permanent and temporary freshwater to slightly brackish lentic habitats, rich in aquatic vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single individual recorded in Soto de Las Cuevas.

PREVIOUS RECORDS: This is the first record of the species in the Park.

Hesperocorixa linnaei (Fieber, 1848)

GENERAL DISTRIBUTION: It is distributed in Europe (except for the most northern regions), North Africa and Central Asia. It is distributed throughout the Iberian Peninsula. It is common and abundant in Madrid.

PREFERRED HABITAT: It occurs in small lakes and permanent ponds with abundant aquatic vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single individual recorded in the gravel pit of Los Frailes.

PREVIOUS RECORDS: In the gravel pit of Los Frailes (García-Avilés, 2002b).

Sigara (Halicorixa) selecta (Fieber, 1848)

GENERAL DISTRIBUTION: It is distributed in Western and Southern Europe, and North Africa. It is distributed throughout the Iberian Peninsula, being more common in the Mediterranean area. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It occurs in both vegetated and non-vegetated stagnant brackish water habitats.

LOCALIZATION IN THE STUDY AREA: This species was recorded once in the gravel pit of Rivas1.

PREVIOUS RECORDS: In the gravel pit of San Antonio 1 (Montes, 1993).

OBSERVATIONS: It should be noted that the gravel pit of San Antonio 1 is currently not exist, as its basin was filled in a few years ago.

Sigara (Vermicorixa) lateralis (Leach, 1817)

GENERAL DISTRIBUTION: It is distributed in Europe, Africa and Asia to India. It is distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It is an opportunistic species which can colonize diverse aquatic environments, from eutrophic lakes to temporary pools.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to 3 gravel pits, Rivas1, Henares River Dam 1 and Ciempozuelos 1.

PREVIOUS RECORDS: It was cited in El Herrero Island and El Campillo (Montes, 1993), and in Henares River Dam 1 and Rivas 1 (García-Avilés, 2002b).

Cymatia rogenhoferi (Fieber, 1864)

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and the Middle East to Southeast Asia. It is common throughout the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in well-vegetated, more or less brackish water habitats.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to 2 wetlands, Rivas1 and Soto de Las Cuevas.

PREVIOUS RECORDS: In El Campillo (Montes, 1993) and in Rivas 1 and Soto de Las Cuevas (García-Avilés, 2002b).

Micronecta (Dichaetonecta) scholtzi (Fieber, 1860)

GENERAL DISTRIBUTION: From Central, Western and Southern Europe to North Africa. It is widely distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It usually occurs in stagnant water habitats, with or without vegetation, from reservoirs and lakes, to slow-flowing small rivers or streams.

LOCALIZATION IN THE STUDY AREA: *M. scholtzi* appeared to be the most common and abundant heteropterous species in the Park. It was recorded in all the studied wetlands, except in Los Frailes and Boyeriza Spring.

PREVIOUS RECORDS: In El Campillo (López *et al.*, 1995; López, 1998; López and Hernández, 2000) and in 16 gravel pits in the Park (García-Avilés, 2002b).

FAMILY: NAUCORIDAE LEACH, 1815

Naucoris maculatus maculatus Fabricius, 1798

GENERAL DISTRIBUTION: It is distributed throughout Southern Europe and North Africa. It is very common in the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in well-vegetated permanent habitats, as well as slow-flowing rivers and streams.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to the gravel pits of Ciempozuelos 1 and Soto de Las Cuevas only. Well-vegetated habitats (with *Typha* and *Phragmites*) appeared to constitute the most preferred habitats for this species.

PREVIOUS RECORDS: In Vaciamadrid (without indicating a date, habitat or exact location, revision of the collections of the Chair of Entomology, Faculty of Biology, Complutense University of Madrid) (López, 1998), and in the gravel pit of Soto de Las Cuevas (García-Avilés, 2002b).

FAMILY: NEPIDAE LATREILLE, 1802

Nepa cinerea Linnaeus, 1758

GENERAL DISTRIBUTION: It is distributed in Europe, North Africa and North and Central Asia. It is distributed throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: This species prefers well-vegetated stagnant waters habitats.
LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to 3 wetlands, Soto de Las Cuevas, Los Frailes and Boyeriza Spring.
PREVIOUS RECORDS: In a small stream in San Martín de la Vega, without giving exact location (Nieser, 1969) and in Boyeriza Spring (García-Avilés, 2002b).

FAMILY: NOTONECTIDAE LATREILLE, 1802

Anisops sardeus sardeus Herrich-Schaeffer, 1849

GENERAL DISTRIBUTION: It is distributed in Southern Europe, North Africa and Asia Minor to India. It is distributed throughout the Iberian Peninsula and more common in the southern half. It is common and abundant in Madrid.
PREFERRED HABITAT: It usually occurs in stagnant waters, whether natural or artificial, temporary or permanent, fresh or brackish and with or without vegetation.
LOCALIZATION IN THE STUDY AREA: This species was recorded in 6 wetlands, Henares Rive Dam 1, Soto de Las Cuevas, San Martín de la Vega 7, Tierno Galván Park, Ciempozuelos 1 and El Campillo 1.
PREVIOUS RECORDS: It was cited in Jarama River at altitude 545 m, near the iron bridge of Arganda (Nieto, 1970; Nieto and Compte, 1970) and in 6 gravel pits in the Park (García-Avilés, 2002b).

Notonecta (Notonecta) maculata Fabricius, 1794

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe and North Africa. It is widely distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.
PREFERRED HABITAT: This species prefers stagnant water habitats, whether natural or artificial, deep or shallow and with or without vegetation.
LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: In the gravel pit of San Martín de la Vega 6 (Montes, 1993) and Boyeriza Spring (García-Avilés, 2002b).

Notonecta (Notonecta) viridis Delcourt, 1909

GENERAL DISTRIBUTION: It is distributed in Western Europe and North Africa. It is widely distributed throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs in well-vegetated lakes, ponds and pools. It can be found in both freshwater and slightly brackish water habitats.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single individual recorded in Rivas 1.

PREVIOUS RECORDS: This species was cited in the gravel pits of San Martín de la Vega 6 (Montes, 1993) and Rivas 1 (García-Avilés 2002b).

FAMILY: PLEIDAE FIEBER, 1851

Plea minutissima minutissima Leach, 1817

GENERAL DISTRIBUTION: It is distributed in Europe, North Africa and Central Asia. It is widely distributed throughout the Iberian Peninsula. It is very common and abundant in Madrid.

PREFERRED HABITAT: It is usually found among aquatic vegetation in lentic habitats, but occasionally in lotic habitats.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Ciempozuelos 1 and Soto de Las Cuevas only.

PREVIOUS RECORDS: This is the first record of the species in the Park.

FAMILY: GERRIDAE LEACH, 1815

Gerris (Gerris) argentatus Schummel, 1832

GENERAL DISTRIBUTION: It is distributed in Europe, North Africa and Central Asia to Japan. It is distributed throughout the Iberian Peninsula, but it is uncommon. It is common and little abundant in Madrid.

PREFERRED HABITAT: It is usually found in stagnant waters including permanent ponds and pools of rivers and streams with emergent or floating vegetation. Due to its flying ability, it can colonize aquatic environments generally considered untypical.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 3 wetlands, Henares River Dam 1, Las Madres 1 and Muñoz.

PREVIOUS RECORDS: It was cited in El Campillo (López *et al.*, 1995; López, 1998; López and Hernández, 2000), and Henares River Dam 1 and Las Madres 1 (García-Avilés 2002b).

Gerris (Gerris) gibbifer Schummel, 1832

GENERAL DISTRIBUTION: It is distributed in Central and Southern Europe, North Africa and Asia Minor. It is widely distributed in the Iberian Peninsula. It is common and abundant in Madrid.

PREFERRED HABITAT: It is usually found in stagnant water habitats, including pools of streams and rivers, and temporary ponds.

LOCALIZATION IN THE STUDY AREA: This species was recorded once in Boyeriza Spring.

PREVIOUS RECORDS: In Boyeriza Spring (García-Avilés 2002b).

Gerris (Gerris) thoracicus Schummel, 1832

GENERAL DISTRIBUTION: It is distributed in Europe, North Africa and Eastern Asia. It is common throughout the Iberian Peninsula. It is common and abundant in Madrid.

PREFERRED HABITAT: It occurs in both permanent and temporary habitats including lakes and ponds, as well as slow-flowing streams.

LOCALIZATION IN THE STUDY AREA: This species was recorded once in Boyeriza Spring.

PREVIOUS RECORDS: In San Martín de la Vega, without giving exact location and habitat, 15-4-1973, revision of the collections of the Chair of Entomology, Faculty of Biology, Complutense University of Madrid (Lopez, 1998) and in Boyeriza Spring (García-Avilés, 2002b).

Gerris (Gerriselloides) asper (Fieber, 1860)

GENERAL DISTRIBUTION: It is distributed in Southern Europe, Asia Minor, Southwest Asia and North Africa. The distribution of this species in the Iberian Peninsula is not well known, since this species was cited recently for the first time in Spain (García-Avilés, 1995; Lopez *et al.*, 1995a). It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It is usually found in well-vegetated habitats, including lakes, rivers and streams with slow water current.

LOCALIZATION IN THE STUDY AREA: This species was recorded once in Boyeriza Spring.

PREVIOUS RECORDS: In Boyeriza Spring (García-Avilés, 2002b).

Gerris (Gerriselloides) lateralis Schummel, 1832

GENERAL DISTRIBUTION: It is distributed in Europe and Asia. It is distributed throughout the Palaearctic region, with few and scattered records at the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: This species prefers well-vegetated permanent habitats.

LOCALIZATION IN THE STUDY AREA: This species was recorded in the gravel pits of San Martín de la Vega 7 and Las Madres 1.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: VELIIDAE BRULLÉ, 1836

Microvelia (Microvelia) pygmaea (Dufour, 1833)

GENERAL DISTRIBUTION: It is distributed in the Southern half of Europe, Asia and North Africa. It is distributed throughout the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It is usually found along the margins of pools, ponds and lakes, and often associated with floating or emergent vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: This species was recorded in Boyeriza Spring by García-Avilés (2002b).

FAMILY: MESOVELIIDAE DOUGLAS AND SCOTT, 1867

Mesovelia vittigera Horváth, 1895

GENERAL DISTRIBUTION: It is distributed in Southern Europe, Africa to Madagascar, Asia to Japan and New Guinea. It is distributed throughout the Iberian Peninsula. It is common and little abundant in Madrid.

PREFERRED HABITAT: It usually occurs on the surface of ponds, lakes and marshes, and is often associated with floating or emergent vegetation.

LOCALIZATION IN THE STUDY AREA: This is a common species in the Park, where it recorded in 10 wetlands, Henares River Dam 1, Henares River Dam 2, San Antonio 5, El Campillo 1, Las Madres 1, Muñoz, Villafranca, San Martín de la Vega 7, Ciempozuelos 1 and Los Frailes.

PREVIOUS RECORDS: This species was cited in 8 wetlands in the Park (García-Avilés 2002b).

- **OTHER HETEROPTERAN SPECIES CITED IN THE SOUTHEAST REGIONAL PARK**

FAMILY: GERRIDAE LEACH, 1815

Aquarius najas (De Geer, 1773)

GENERAL DISTRIBUTION: It is distributed in Europe and North Africa. It is widely distributed in the Iberian Peninsula. It is uncommon and little abundant in Madrid.
PREFERRED HABITAT: It occurs in backwater pools of rivers and permanent streams, with or without vegetation.
PREVIOUS RECORDS: This species was cited by Hernando Díaz (1980) and López (1998) in Arganda del Rey and San Martín de la Vega, without indicating the exact location or type of habitat. Both citations are based on the revision of the collections of the Chair of Entomology, Faculty of Biology, Complutense University of Madrid.

FAMILY: CORIXIDAE LEACH, 1815

Sigara (Halicorixa) stagnalis stagnalis (Leach, 1817)

GENERAL DISTRIBUTION: It is distributed in Europe (except its northernmost parts) and North Africa. It is distributed throughout the Iberian Peninsula. It is uncommon and little abundant in Madrid
PREFERRED HABITAT: It occurs in brackish water habitats, with or without vegetation.
PREVIOUS RECORDS: This species was cited in El Campillo between 1987 and 1989 (López *et al.*, 1995; López, 1998; López and Hernández, 2000).

Sigara (Sigara) dorsalis (Leach, 1817)

GENERAL DISTRIBUTION: It is distributed in Europe. In the Iberian Peninsula, it has been found only in Catalonia and Madrid. The only place where this species has been cited in Madrid is the gravel pit of San Martín de la Vega 6 (Montes, 1993).

PREFERRED HABITAT: It occurs in backwater pools of streams, lakes and ponds, with abundant vegetation.

PREVIOUS RECORDS: This species was cited in the gravel pit of San Martín de la Vega 6 (Montes, 1993).

FAMILY: NOTONECTIDAE LATREILLE, 1802

Notonecta meridionalis Poisson, 1926

GENERAL DISTRIBUTION: It is distributed in Southern Europe, North Africa and Asia Minor. It is distributed throughout the Iberian Peninsula. It is uncommon and little abundant in Madrid.

PREFERRED HABITAT: It occurs in well-vegetated ponds and lakes.

PREVIOUS RECORDS: This species was cited in a non-vegetated small pond, 16 Km north of Aranjuez (Nieser, 1969).

5.1.7. WATER BEETLES (COLEOPTERA LINNAEUS, 1758)

Water beetles represent the world's most speciose animal order. Although about 400,000 species have been described until today, some biodiversity experts estimate that millions of species may actually roam the earth (Jäch and Balke, 2008).

Water beetles occur as larvae, adults, or both in a wide variety of aquatic and semiaquatic environments. The quality of water is not as restrictive as it is to some aquatic insects because many water beetles use atmospheric rather than dissolved oxygen for respiration. Therefore only a few Coleoptera are recognized are indicator organisms of environmental health. Their main indicator value is in the physical type of habitat they utilize (Mackie, 2001). They are known from brackish waters, hot springs, intertidal zones, aquifers, and tree holes, for example, as well as virtually all common freshwater habitats waters (McCafferty, 1998). In contrast to other insects, water beetles prefer small, richly vegetated ditches. In larger lakes, they prefer the swampy margins (Jäch and Balke, 2008). Depending on the species, they can be found in or on the substrate, in or on the aquatic plants, or swimming at or beneath the surface of the water (McCafferty, 1998).

Most water beetles are benthic organisms, Gyrinidae adults (and some Staphylinidae) are neuston dwellers, which can glide on the water surface; other species (e.g., some Hydraenidae, Hydrophilidae and Lampyridae) can be found ''walking'' upside-down on the underside of the surface film, and some are living exclusively on water plants or on their mammal hosts. A considerable number of water beetles are able to swim and dive. Many species, especially those which live in well-oxygenated running waters (Elmidae, Hydraenidae adults) stay submerged for most of their life and breathe by means of a microplastron (a very thin layer of air, held by a dense coating of hydrofuge setae). Some Elmidae were encountered down to a depth of more than 10 m below the water surface (Jäch and Balke, 2008). Aquatic larvae may be hydropneustic or aeropneustic, depending on the species. A few species (e.g. crawling water beetles, Haliplidae) develop functional spiracles only in later instars. Among hydropneustic forms, oxygen may be taken up directly through membranous areas of the body, the gills, or both, or via plastron. Aquatic leaf beetles (Chrysomelidae) are examples of aeropneustic larvae that are endophytic breathers. They tap the oxygen available in aquatic plants with their specialized terminal spiracles (McCafferty, 1998).

Among all developmental stages of beetles (eggs, larvae, pupae and adults), larvae and adults are most commonly found underwater. It should be noted here that there is no species of Coleoptera (except maybe some stygobiontic ones) that does not voluntarily leave water for at least some hours (e.g., for pupation and/or dispersal flight) during its life. In other words, no water beetle has so far been confirmed to be ecologically 100% "aquatic" as, for example, whales or most fishes (Jäch, 1998). The life histories of water-associated beetles are in fact extremely manyfold, differing greatly between families. In Coleoptera aquatic and terrestrial behaviour very often grade almost imperceptibly into each other at the water's edge. The difficulties in the ecological classification are related mainly to the following factors: (1) amount of time spent in contact with water, (2) degree of submergence, (3) degree of water dependance, (4) motivation for getting into contact with water (food, refuge, etc.) (Jäch and Balke, 2008).

Based on more than 40 families of beetles more or less strongly associated with aquatic habitats Jäch (1998) defined six ecological groups: (1) "True Water Beetles" (at least partly submerged for most of the time of their adult stage), (2) "False Water Beetles" (submerged for most of the time of their larval stage, adults always predominantly terrestrial), (3) "Phytophilous Water Beetles" (living and feeding on water plants (mono- or oligophagous), submerged for at least some time in any developmental stage), (4) "Parasitic Water Beetles" (like Phytophilous Water Beetles, but their hosts are aquatic mammals), (5) "Facultative Water Beetles" (actively submerged (occasionally or regularly) or actively dwelling on the water surface (occasionally or regularly) for a limited period of time, e.g., while hunting, feeding, seeking refuge, etc., during any of their developmental stages in at least one population) and (6) "Shore Beetles" (riparian, living close to the water's edge during all their developmental stages, not entering water voluntarily). With a few exceptions, the amount of time spent in contact with water is gradually decreasing from category 1–6.

GLOBAL DIVERSITY OF COLEOPTERA

Jäch and Balke (2008) studied the global diversity of water beetles in freshwater. The order Coleoptera is comprised of four suborders, three of which have aquatic representatives: Myxophaga (77 described species, ca. 90% aquatic), Adephaga (ca. 30,000 described species, ca. 18% aquatic), and Polyphaga (ca. 370,000 described species, ca. 1.25% aquatic).While truly terrestrial species are an exception in the Myxophaga (Lepiceridae , Torridincolidae, Hydroscaphidae and Sphaeriusidae), 8 of the 11 extant families of Adephaga are regarded as predominantly aquatic (Gyrinidae, Haliplidae, Meruidae, Noteridae, Amphizoidae, Aspidytidae, Hygrobiidae and Dytiscidae), and only 13 of the ca. 150 recognized families of the large suborder Polyphaga are regarded as "predominantly aquatic" (Helophoridae, Epimetopidae, Hydrochidae, Spercheidae, Hydrophilidae, Hydraenidae, Scirtidae, Elmidae, Dryopidae, Lutrochidae, Psephenidae, Cneoglossidae and Eulichadidae).

Only six of the aquatic families supposed to include at least 1,000 species of water beetles: Dytiscidae, Hydraenidae, Hydrophilidae, Elmidae, Scirtidae and Gyrinidae. Without any doubt Dytiscidae are the world's most speciose water beetle family. With an estimated total of 4,800 species, there are about as many dytiscids as in the next two families (Hydraenidae and Hydrophilidae) taken together. Hydrophilidae are presently regarded as the second most speciose family. However, with the inclusion of the estimated undescribed species, hydraenids will soon overtake hydrophilids in the diversity ranking. Each of these two families probably comprises distinctly more than 2,000 species. Elmidae and Scirtidae follow next with somewhat less than 2,000 species. Gyrinidae represent a family of medium diversity, with an estimated 1,000 species (Jäch and Balke, 2008).

Water beetles are found in all biogeographic regions. And although, on average, diversity is greater in humid climates, some of the desert regions are quite rich in water beetles. Water beetles display their greatest diversity in the tropics. Haliplidae, Amphizoidae and Helophoridae are the only exception to this rule. Haliplidae are distinctly more diverse in the Holarctic Realm than in any of the tropical regions, and although most tropical countries are still rather poorly examined we do not expect a significant increase of species in this family. Helophoridae are even more strongly confined to the northern temperate regions; a mere 0.7% of the species are found outside the Holarctic Region! All five known species of Amphizoidae are Holarctic (Jäch and Balke, 2008).

Counting the described species, the Palearctic Region houses the highest number of water beetles species. Although comprehensive water beetle surveys are still lacking for large parts of the Neotropical and Afrotropical Realms, it is estimated (after including the undescribed species) that the Palearctic (ca. 3,350 described species/ca. 3,900 estimated total), the Neotropical (2,510/3,900), and the Afrotropical Region (2,700/3,750) harbor more or less the same number of water beetle species, followed by the Oriental (2,200/3,580) and the Australian/Pacific Realm (1,340/2,100). Undoubtedly, the Nearctic (1,420/1,550) is by far the poorest region in terms of water beetle diversity (Figure 5.1.6). Within the Palearctic Region, the Mediterranean countries and Anatolia are to be regarded as biodiversity hot spots, at least for certain families (Jäch and Balke, 2008).

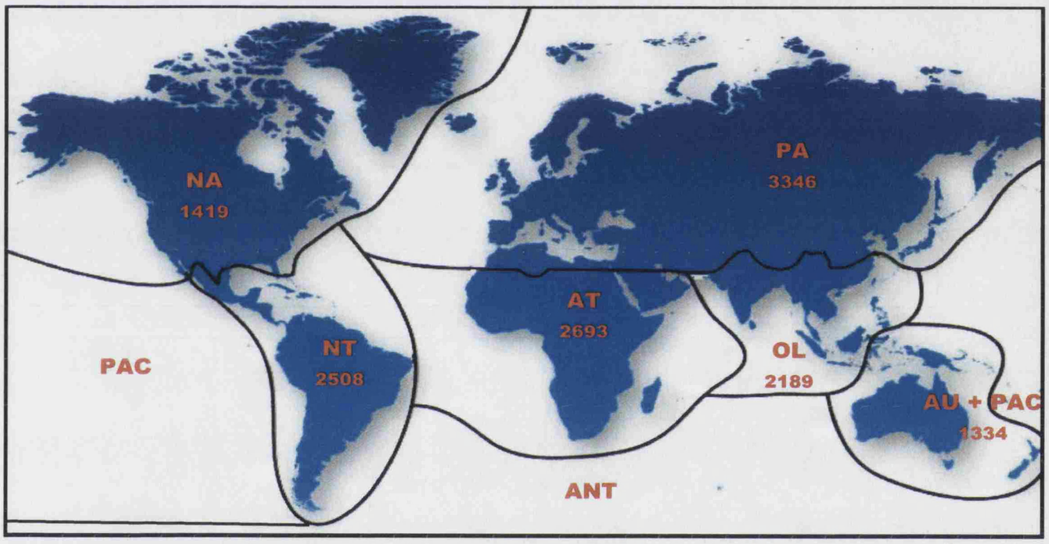


Figure (5.1.6): Aquatic Coleoptera diversity: number of species per realm. Species from the Antarctic Region (ANT) and the Pacific Region (PAC) have been included to adjacent realms. AU: Australia; AT: Afrotropical; NA: Nearctic; NT: Neotropic; OL: Oriental; PA: Palearctic; PAC: Pacific. After Jäch and Balke (2008).

ORDER: COLEOPTERA LINNAEUS, 1758

FAMILY: HYDROSCAPHIDAE LECONTE, 1874

Hydroscapha LeConte, 1874

GENERAL DISTRIBUTION: It is distributed in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. *Hydroscapha granulum* (Motschulsky, 1855) is the only species recorded in Spain and it is distributed in Madrid and Badajoz.

PREFERRED HABITAT: Species of the genus *Hydroscapha* occur as larvae and adults in streams, hot springs and pools, feeding upon algae. They are known to be tolerant of a wide range of water temperature.

LOCALIZATION IN THE STUDY AREA: The presence of this specie was represented by a single adult recorded in Las Madres 3.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

FAMILY: GYRINIDAE LATREILLE, 1806

Genus: *Gyrinus* O. F. Müller 1764

GENERAL DISTRIBUTION: It is distributed throughout most parts of the world. The species related to the Iberian *Gyrinus* may be northern species (present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa) or trans-Iberian species (present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa). *G. dejeani, G. substriatus* and *G. urinator* are the only species recorded in Madrid (Martínez and Sáez, 1883; Fuente, 1921; Pardo, 1933; Vélaz and Ugarte, 1933; Lindberg, 1939; Bertrand, 1954; Fery and Fresneda, 1988).

PREFERRED HABITAT: Species of the genus *Gyrinus* occur in both running and stagnant water where the surface is not covered by too much vegetation. Many of the European species are known to fly, and are often attracted to light.

LOCALIZATION IN THE STUDY AREA: The larvae of *Gyrinus* were recorder in 3 wetlands, El Campillo 1, Las Madres 1 and Las Madres 3.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

FAMILY: HALIPLIDAE KIRBY, 1837

Haliplus (Neohaliplus) lineatocollis (Marsham, 1802)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Martínez and Sáez (1883), Fuente (1921), Pardo (1933), Falkenström (1939), Lindberg (1939), Bertrand (1957) and Fery and Fresneda (1988).

PREFERRED HABITAT: Live in ponds, streams, rivers and swamps, even in brackish and salt water. The larvae, and perhaps also the adult, feeds on filamentous algae. It has been observed flying on many occasions.

LOCALIZATION IN THE STUDY AREA: Adults of this species were restricted to Boyeriza Spring only. Larvae were recorded in Rivas 1 only.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: NOTERIDAE C. G. THOMSON, 1860

Noterus laevis Sturm, 1834

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, Northwestern Africa and the Iberian Peninsula. It was recorded in Madrid by Lindberg (1939).

PREFERRED HABITAT: Live in fresh and, sometimes, brackish waters, stagnant or slow-flowing, rich in debris and vegetation.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 4 wetlands, Henares River Dam 2, El Campillo 1, Soto de Las Cuevas and Los Frailes. Well-vegetated habitats (with *Typha*) appeared to constitute the most preferred habitats for this species.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: DYTISCIDAE LEACH, 1815

Agabus (Gaurodytes) bipustulatus (Linnaeus, 1767)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Martínez and Sáez (1883), Pardo (1933), Lindberg (1939), Bertrand (1954) and Fery and Fresneda (1988).

PREFERRED HABITAT: It can be found in all types of water body, including shallow lakes with stony or silty bottoms, small bodies of running water and also in springs and ponds with little vegetation.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in Boyeriza Spring only.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Agabus (Gaurodytes) nebulosus (Forster, 1771)

GENERAL DISTRIBUTION: It is distributed in Europe north of the Pyrenees and North Africa. Its range covers fully the Iberian Peninsula and Balearic Islands. It was recorded in Madrid by Lindberg (1939).

PREFERRED HABITAT: It occurs in ponds and pools of mainly recent origin, such as gravel-pits and ditches. It is also found, but rarely in brackish water. Most often found on sand, silt or clay without vegetation. Adults are good fliers.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 2 wetlands, Rivas1 and Boyeriza Spring. Larvae were recorded in San Antonio 5, Los Frailes and Boyeriza Spring.

PREVIOUS RECORDS: In the gravel pit of San Antonio 5 (Montes, 1993).

Genus: *Ilybius* Erichson, 1832

GENERAL DISTRIBUTION: Most Iberian species of the genus *Ilybius* are present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. Three species of this genus were recorded in Madrid, *I. ater, I. fenestratus* and *I. meridionalis* (Sharp, 1872; Fuente, 1921; Pardo, 1933; Vélaz and Ugarte, 1933; Alvarez and Agulló, 1981).

PREFERRED HABITAT: It is found mainly in well-vegetated stagnant water habitats. Females insert their eggs into the tissues of aquatic plants.

LOCALIZATION IN THE STUDY AREA: Larvae were recorded in 3 gravel pits, San Antonio 5, Soto de Las Cuevas and Los Frailes.

Previous records: This is the first record of this genus in the Park.

Colymbetes fuscus (Linnaeus, 1758)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Seidltiz (1867), Martínez and Sáez (1883), Pardo (1933), Lindberg (1939), Bertrand (1954) and Régil *et al.* (1986).

PREFERRED HABITAT: It usually occurs in stagnant water and often in clay ponds, but also in detritus ponds.

LOCALIZATION IN THE STUDY AREA: The presence of this species was represented by a single individual recorded in Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Rhantus (Rhantus) hispanicus Sharp 1882

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Sharp (1880-82) and Fery and Fresneda (1988).

PREFERRED HABITAT: Usually found in well-vegetated stagnant water habitats.

LOCALIZATION IN THE STUDY AREA: This species was recorded once in Boyeriza Spring and represented by a single individual.

PREVIOUS RECORDS: This is the first record of this species in the Park.

***Rhantus (Rhantus) suturalis* (MacLeay, 1825)**

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. This is the first record of this species in Madrid.

PREFERRED HABITAT: Typically found in small clay pools on coastal meadows. Other habitats include various shallow ponds, mainly with little or no vegetation.

LOCALIZATION IN THE STUDY AREA: It was recorded in 3 wetlands, San Antonio 5, San Martín de la Vega 7 and Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

***Hydroglyphus geminus* (Fabricius, 1792)**

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Lindberg (1939).

PREFERRED HABITAT: The main habitat is in open silt pools, often man-made and of recent origin. It also occurs in rock pools and at lake margins. It is an active flyer.

LOCALIZATION IN THE STUDY AREA: This species was recorded in 2 wetlands, Rivas1 and Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park.

***Hydroglyphus signatellus* (Klug, 1834)**

GENERAL DISTRIBUTION: Present in North Africa and in some areas of the Iberian Peninsula (South and Central Iberia, up to the Central Ebro valley), but not extending north of the Pyrenees. This is the first record of this species in Madrid.

PREFERRED HABITAT: Typically found in highly mineralized water but generally at elevated temperatures.

LOCALIZATION IN THE STUDY AREA: Adults of this species were restricted to the non-vegetated habitats of Rivas1 only.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

Graptodytes flavipes (Olivier, 1795)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Martínez and Sáez (1883), Fuente (1921), Pardo (1933), Lindberg (1939) and Bertrand (1954 and 1957).

PREFERRED HABITAT: It is usually occurs in shallow, stagnant, or slow-flowing water habitats.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring and represented by two individuals.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Hydroporus nigrita (Fabricius, 1792)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. It was recorded in Madrid by Sharp (1880-82), Fuente (1921), Falkenström (1939), Bertrand (1954) and Fery and Fresneda (1988).

PREFERRED HABITAT: It is an inhabitant of various small standing and slow-moving water bodies, usually with a mineral or peaty substrate. It is frequently collected in small streams, roadside ditches and cold springs.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: The genus *Hydroporus* was recorded in the gravel pit of San Antonio 5 by Montes (1993). This is the first record *H. nigrita* in the Park.

Hydroporus obsoletus Aubé, 1838

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. This is the first record of this species in Madrid.

PREFERRED HABITAT: The main habitats appear to be in springs and spring-fed streams. It has also been found in other small bodies of running or seeping water. The species has been recorded as flying.

LOCALIZATION IN THE STUDY AREA: Adults of this species were restricted to Boyeriza Spring only.

PREVIOUS RECORDS: The genus *Hydroporus* was recorded in the gravel pit of San Antonio 5 by Montes (1993). This is the first record of *H. obsoletus* in the Park and in Madrid.

Hydroporus pubescens (Gyllenhal, 1808)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Lindberg (1939), Bertrand (1954, 1956 and 1957) and Fery and Fresneda (1988).

PREFERRED HABITAT: It occurs in various small, fresh or slightly brackish, stagnant water bodies with little or without vegetation, preferably unshaded areas. This species is a regular inhabitant of rock pools.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 2 wetlands, Los Frailes and in Boyeriza Spring.

PREVIOUS RECORDS: The genus *Hydroporus* was recorded in the gravel pit of San Antonio 5 by Montes (1993). This is the first record of *H. pubescens* in the Park.

Genus: *Oreodytes* Seidlitz, 1887

GENERAL DISTRIBUTION: Species related to the Iberian *Oreodytes* may be northern species (present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa) or endemic species (present only in the Iberian

Peninsula, including the north face of the Pyrenees and some areas in the extreme south of France) in some cases. Two species *Oreodytes* were recorded in Madrid *O. davisii* and *O. Sanmarkii* (Fuente, 1921; Bertrand, 1954 and 1957; Fery and Fresneda, 1988).

PREFERRED HABITAT: Most species occur in running water or at exposed lake margins, generally at high altitude or high latitude. They usually prefer shallow, rapidly running, cool water with sandy and gravelly or solid bottom.

LOCALIZATION IN THE STUDY AREA: Larvae of genus *Oreodytes* were recorded in 2 wetlands, San Antonio 5 and Tierno Galván Park.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

Stictonectes lepidus (Olivier, 1795)

GENERAL DISTRIBUTION: In Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Martínez and Sáez (1883), Fuente (1921), Pardo (1933), Franciscolo (1979) and Fery and Fresneda (1988).

PREFERRED HABITAT: Occurs in ponds, lakes, canals and streams at low altitude.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Stictotarsus griseostriatus (De Geer, 1774)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. This is the first record of this species in Madrid.

PREFERRED HABITAT: In both lentic and lotic habitats. This tends to be a colonizing species, found in newly formed habitats or habitats that have been physically disturbed by factors such as ice or water scour or water level fluctuation so that much of the substrate is bare and composed of mineral materials such as clay, sand or rock.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 3 wetlands, El Porcal 9, Camping Lagos 1 and Muñoz.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

Hydrovatus cuspidatus (Kunze, 1818)

GENERAL DISTRIBUTION: Mainly a Mediterranean species present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. This is the first record of this species in Madrid.

PREFERRED HABITAT: It occurs in stagnant water bodies rich in vegetation, often at eutrophic lake margins.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 3 wetlands, Henares River Dam 2, El Campillo 1 and Los Frailes. Larvae of *Hydrovatus* were recorded in 4 wetlands, Henares River Dam 2, El Campillo 1, Los Frailes and Boyeriza Spring. Habitats vegetated with *Typha* sp. appeared to constitute the most preferred habitats for this species.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

Hygrotus (Hygrotus) inaequalis (Fabricius, 1777)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. This is the first record of this species in Madrid.

PREFERRED HABITAT: It occurs in permanent stagnant water bodies rich in vegetation.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Los Frailes only.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

Laccophilus hyalinus (De Geer, 1774)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Lindberg (1939).

PREFERRED HABITAT: It is usually found in large bodies of running water, in sections with a slow current and some vegetation.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 2 wetlands, San Antonio 5 and Los Frailes.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Laccophilus minutus (Linnaeus, 1758)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Martínez and Sáez (1883), Pardo (1933), Vélaz and Ugarte (1933), Lindberg (1939) and Bertrand (1957).

PREFERRED HABITAT: The main habitat is in more permanent bodies of stagnant water such as lakes and ponds, often with little or without vegetation. Adults are capable of flight.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 2 wetlands, Soto de Las Cuevas and Boyeriza Spring. Larvae of *Laccophilus* were recorded in 8 wetlands (Henares River Dam 2, Rivas1, El Campillo 1, El Porcal 9, Ciempozuelos 1, Soto de Las Cuevas, Los Frailes and Boyeriza Spring) and appear to live in habitats with or without vegetation.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: HELOPHORIDAE LEACH, 1815

Helophorus (Helophorus) aquaticus (Linnaeus, 1758)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Graells (1846, 1847 and 1850), Seidlitz (1867), Sharp (1872 and 1878), Fuente (1925) and Angus (1970 and 1982).

PREFERRED HABITAT: It occurs in stagnant freshwater, usually in small, shallow and muddy pools. It is apparently prefers more shaded waters, often in boggy ground.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: This is the first record of this species in the Park.

OBSERVATIONS: This species was records from Morocco by Kocher (1958), but probably refer to another species. *H. aquaticus* is likely to be a northern species; present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa (Ribera *et al.,* 1998; Löbl and Smetana, 2004).

Helophorus (Rhopalohelophorus) brevipalpis Bedel, 1881

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. This is the first record of this species in Madrid.

PREFERRED HABITAT: It occurs usually in stagnant freshwater, preferring shallow, more or less open, often temporary pools with grassy bottom.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 5 wetlands, El Porcal 9, San Martín de la Vega 7, Ciempozuelos 1, Los Frailes and Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

Helophorus (Rhopalohelophorus) flavipes Fabricius, 1792

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. It was recorded in Madrid by d'Orchymont (1935) and Angus (1996).

PREFERRED HABITAT: It occurs in fresh, predominantly stagnant waters, normally in small acid pools with some vegetation.

LOCALIZATION IN THE STUDY AREA: It was recorded in 5 wetlands, Henares River Dam 1, Henares River Dam 2, Villafranca, San Martín de la Vega 7 and Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Helophorus (Rhopalohelophorus) minutus Fabricius, 1775

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees and some areas in Central and Southern Iberian Peninsula, but not in North Africa. This is the first record of this species in Madrid.

PREFERRED HABITAT: It occurs in stagnant, only occasionally running, freshwater, mainly in shallow, open, eutrophic pools with grassy and usually clayey bottom, particularly in rather light-bottomed pools. The species is an active flyer, frequently found in drift on the seashore.

LOCALIZATION IN THE STUDY AREA: It was recorded in Boyeriza Spring only.

PREVIOUS RECORDS: This is the first record of this species in the Park and in Madrid.

OBSERVATIONS: The southern limit of the distribution of *H. minutus* is unknown and its presence in North Africa uncertain (Ribera *et al.*, 1998).

Helophorus (Trichohelophorus) alternans Gené, 1836

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Sharp (1915), Fuente (1925) and d'Orchymont (1935).

PREFERRED HABITAT: It occurs in clean, moderately fast running streams.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 4 wetlands, Henares River Dam 2, Las Madres 1, Soto de Las Cuevas and Los Frailes.

PREVIOUS RECORDS: This is the first record of this species in the Park.

FAMILY: HYDROPHILIDAE LATREILLE, 1802

Anacaena globulus (Paykull, 1798)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Fuente (1925) and Berge Henegouwen (1986).

PREFERRED HABITAT: Predominantly in running waters and sometimes in shallow stagnant water habitats, usually at the grassy edges and among the submerged vegetation.

LOCALIZATION IN THE STUDY AREA: Adults were recorded in El Campillo 1 and Los Frailes.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Berosus (Berosus) hispanicus Küster, 1847

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Schödl (1993).

PREFERRED HABITAT: It is found in both lotic and lentic freshwater habitats. It is apparently adapted to slightly brackish water habitats.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in Rivas1 only. Larvae of the genus *Berosus* were recorded in Henares River Dam 2 and Rivas1.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Enochrus (Lumetus) sp. cfr. *bicolor* (Fabricius 1792)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, the Iberian Peninsula, and North Africa. It was recorded in Madrid by Schödl (1998).

PREFERRED HABITAT: Usually in brackish water near the costs; also in slow-flowing water, e.g. draining canals. It obviously tolerates lower salinities, and is sometimes, although very occasionally, found in freshwater, and then mainly at the edges of the lakes.

LOCALIZATION IN THE STUDY AREA: The presence of this species was restricted to San Martín de la Vega 7 and represented by a single individual.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Helochares (Helochares) lividus (Forster, 1771)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by d'Orchymont (1935).

PREFERRED HABITAT: Usually in stagnant and occasionally running water habitats with a luxurious vegetation of floating leaved and submerged plants on mineral soils.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 7 wetlands (El Campillo 1, El Porcal 9, Las Madres 3, Ciempozuelos 1, Soto de Las Cuevas, Los Frailes and Boyeriza Spring). Larvae of genus *Helochares* were widely distributed in the Park, where it recorded in 11 wetlands (Henares River Dam 1, Henares River Dam 2, El Campillo 1, Rivas 1, Soto de Las Cuevas, Los Frailes, Ciempozuelos 1, Tierno Galván Park, San Martín de la Vega 7, Boyeriza Spring and El Porcal 9). Generally, it showed a clear preference for habitats vegetated with *Typha* and *Phragmites* and occasionally found in non-vegetated habitats.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Hydrobius fuscipes (Linnaeus, 1758)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Champion and Champion (1905) and Fuente (1925).

PREFERRED HABITAT: Mainly in stagnant water, but also at the slower reaches of streams, in both fresh and brackish water; in eutrophic water normally very abundant, but also rather frequent in more oligotrophic waters. It is usually found among vegetation on shallow places near the edge.

LOCALIZATION IN THE STUDY AREA: The presence of this species in the Park was restricted to Boyeriza Spring only.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Laccobius (Dimorpholaccobius) sinuatus Motschulsky, 1849

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Gentili (1988).

PREFERRED HABITAT: Predominantly at sparsely covered or bare edges of slowly running waters, especially in streams with clayey or silty, light bottom, in very shallow water or in wet mud at the edges. It occurs also in clay pits at groundwater pools and slow-flowing trickles.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in 3 wetlands, Villafranca, Ciempozuelos 1 and Boyeriza Spring. Larvae of genus *Laccobius* were recorded in 4 wetlands, Rivas1, Las Madres 3, Muñoz and Ciempozuelos 1.

PREVIOUS RECORDS: This is the first record of this species in the Park.

Genus: *Coelostoma* Brullé, 1835

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees and the Iberian Peninsula. Some species may be found in North Africa and others no. Two species are known for Spain *C. hispanicum* and *C. Orbiculare.* These two species were recorded in Madrid by Sharp (1872 & 1878) and Focarile (1971).

PREFERRED HABITAT: In stagnant freshwater, mainly at the edges of eutrophic, open, well-vegetated ponds, among vegetation in shallow water at the edge. Some species are able to live in acid or less eutrophic waters.

LOCALIZATION IN THE STUDY AREA: The presence of the larvae of *Coelostoma* was restricted to El Porcal 9 only.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

FAMILY: HYDRAENIDAE MULSANT, 1844

Genus: *Hydraena* Kugelann, 1794

GENERAL DISTRIBUTION: *Hydraena* is the largest genus within the family Hydraenidae, including some 700 species worldwide. It is distributed over all parts of the world; Europe, North Africa and the Iberian Peninsula. There are about 13 species of *Hydraena* were recorded in Madrid (Rey, 1886; Kuwert, 1890; Fuente, 1925; Berthelemy, 1986; d'Orchymont, 1936; Ienistea, 1978; García de Jalón and González del Tánago, 1982; Casado *et al.*, 1990; Valladares, 1992).
PREFERRED HABITAT: They are primarily crawl along the margins of streams, often in tangled roots and debris, or in or around freshwater and brackish pools, intertidal areas, or warm springs. They are often associated with filamentous algae and leaf detritus. Larvae are not adapted for aquatic respiration. The majorities of the species are obviously confined to clear and unpolluted waters, and may serve as indicators for pollution.
LOCALIZATION IN THE STUDY AREA: The presence of this genus was represented by a single adult recorded in San Antonio 5.
PREVIOUS RECORDS: This is the first record of this genus in the Park.

Genus: *Limnebius* Leach 1815

GENERAL DISTRIBUTION: It has a world-wide distribution, with more than 120 described species, of which more than 2/3 is from the Palaearctic Region (Jäch, 2004). *L. truncatellus* is the only species recorded in Madrid (Fuente, 1925; d'Orchymont, 1941 and 1945).
PREFERRED HABITAT: It is found in both stagnant and running water, mainly in shallow water among vegetation.
LOCALIZATION IN THE STUDY AREA: The presence of this genus was represented by a single adult recorded in Boyeriza Spring.
PREVIOUS RECORDS: This is the first record of this genus in the Park.

Genus: *Ochthebius* Leach, 1815

GENERAL DISTRIBUTION: A large genus with a worldwide distribution. Present in Europe, North Africa and the Iberian Peninsula. Three species of this genus were recorded in Madrid, *O. nanus*, *O. pedicularius* and *O. punctatus* (Fuente, 1925; Balfour-Browne, 1978).

PREFERRED HABITAT: Live in streams or shallow marshes. It is found in both running and stagnant freshwater habitats. Some species are adapted to live in salt marshes and others capable of living or growing only within a limited range of temperature.

LOCALIZATION IN THE STUDY AREA: Adults of this genus were recorded in 4 wetlands, Henares River Dam 2, Los Frailes, Boyeriza Spring and Gózquez Reservoir.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

FAMILY: SCIRTIDAE FLEMING, 1821

Genus: *Cyphon* Paykull, 1799

GENERAL DISTRIBUTION: A large genus with a worldwide distribution. Most of the Iberian species appear to be northern species (present in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa). Other species may be Trans-Iberian, southern or endemic species.

PREFERRED HABITAT: Adults are usually encountered on plant surfaces, but they are relatively short-lived. Larvae are usually aquatic, occurring in phytotelmata, running water, stagnant water, such as ponds, lakes or tree holes; a few Southern Hemisphere forms, however, have been collected in moist, rotten wood well away from water.

LOCALIZATION IN THE STUDY AREA: Larvae of this genus were recorded in Soto de Las Cuevas only.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

Genus: *Hydrocyphon* Redtenbacher, 1858

GENERAL DISTRIBUTION: *Hydrocyphon* appear a wide range of distribution. The Iberian species may be northern, endemic or eastern species.

PREFERRED HABITAT: Adults are usually terrestrial, but occasionally collected under water. Pupae are also reported to be aquatic. Larvae are usually aquatic, found in running waters, in stagnant water, phytotelmata, and in groundwater.

LOCALIZATION IN THE STUDY AREA: Larvae of this genus were recorded in 3 wetlands, Henares River Dam 1, San Antonio 5 and Las Madres 3.

PREVIOUS RECORDS: This is the first record of this genus in the Park.

FAMILY: DRYOPIDAE BILLBERG, 1820

Dryops luridus (Erichson 1847)

GENERAL DISTRIBUTION: Present in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by Dodero (1918), Zariquiey (1919) and Codina (1920).

PREFERRED HABITAT: Larvae are generally riparian or terrestrial. Adults are regarded as aquatic (lotic and lentic habitats) associated with mud in ponds, fens and rivers.

LOCALIZATION IN THE STUDY AREA: Adults of this species were recorded in Boyeriza Spring only. Larvae were recorded in El Porcal 9 and Boyeriza Spring.

PREVIOUS RECORDS: This is the first record of this species in the Park.

- **OTHER COLEOPTERAN SPECIES CITED IN THE SOUTHEAST REGIONAL PARK**

FAMILY: DYTISCIDAE LEACH, 1815

Nebrioporus (Zimmermannius) canaliculatus (Lacordaire, 1835)

GENERAL DISTRIBUTION: It is distributed in Europe north of the Pyrenees and some areas in the Iberian Peninsula, but not in North Africa. It was recorded in Madrid by Sharp (1878) and Fuente (1921).

PREFERRED HABITAT: It inhabits silty or sandy ponds of recent origin and almost without vegetation, such as gravel pit ponds.

PREVIOUS RECORDS: This species was cited in the gravel pits of Los Angeles 1 and Ticosa 1 (Montes, 1993).

FAMILY: HYDROPHILIDAE LATREILLE, 1802

Berosus (Berosus) affinis Brullé, 1835

GENERAL DISTRIBUTION: It is distributed in Europe north of the Pyrenees, North Africa and the Iberian Peninsula. It was recorded in Madrid by d'Orchymont (1935) and Schödl (1993).

PREFERRED HABITAT: It occurs in stagnant water with marshy vegetation.

PREVIOUS RECORDS: This species was cited in the gravel pit of Velilla 2 (Montes, 1993).

5.1.8. CADDISFLIES (TRICHOPTERA KIRBY, 1813)

Caddisflies constitute a highly advanced order of insects, closely related to the Lepidoptera, but adapted for aquatic life in the immature stages. Trichoptera are divided in three suborders Annulipalpia, Integripalpia and Spicipalpia (Kjer *et al.*, 2002). Adult Trichoptera range in size over two orders of magnitude, from minute with a wing span of less than 3 mm, to large with a wing spans approaching 100 mm (de Moor and Ivanov, 2008). Although adult caddisflies are essentially mothlike, the scientific name (from *trichos* meaning "hair", and *petron* meaning "wing" attests to their characteristic wings, which usually possess hairs rather than the scales typical of moth wings. And although larval caddisflies are essentially caterpillar-like, the common name "caddis" was probably derived from an allusion to their general habit of constructing either nets or cases (McCafferty, 1998).

Caddisflies are common bottom fauna in most freshwater lotic habitats, such as springs, streams and rivers and in lentic water bodies such as ponds, lakes and temporary pools. They occur in association with all substrate types, and some can live in seepage areas or, rarely, on wet terrestrial surfaces adjacent to water. Some commonly occur in association with the underwater parts of aquatic vegetation (Mackay and Wiggins 1979; McCafferty, 1998). Certain species are tolerant of high salinities and species in one family, the Chathamiidae, have managed to colonise tidal pools along the sea shore in New Zealand and eastern Australia; some species inhabit the brackish inshore waters of the Baltic and White seas (de Moor and Ivanov, 2008). Trichoptera also exhibits different feeding types, including herbivorous, detritivorous and carnivorous species. Like other merolimnic insects caddisflies are only able to disperse among water bodies as adults when they are able to fly. Some species are known to be strong fliers such as *Stenophylax* or *Mesophylax* (Malicky 1987) which are known to fly distances up to 5 km. Other studies have shown that species stay close to the stream where they hatched (Sode and Wiberg-Larsen, 1993; Petersen *et al.*, 2004; Winterbourn *et al.*, 2007).

Trichoptera are holometabolous insects. Adults are generally live between one and two months, some times much more or less, depending on species and nature of habitat, and they are herbivorous liquid feeders. Males possess scent glands that lure the females into a swarm, generally over water. After gathering, a pair leaves the swarm from where they fly to the bank to copulate on river vegetation. Oviposition behaviour is varied, but females generally lay strands or masses of eggs in the water by dipping the abdomen or by crawling or diving into the water. Eggs of a few species are deposited near the water's edge or above the water in vegetation. Dew, fog, or rain liquefies the gelatinous material within which the eggs are laid, allowing eggs or newly hatched larvae to drop or migrate into the water. Eggs of some species remain dormant during dry periods in intermittent streams (Williams and Feltmate, 1992; McCafferty, 1998).

Trichoptera larvae are probably best known for the transportable cases and fixed shelters that many, though not all, species construct. Silk has enabled Trichoptera larvae to develop an enormous array of morphological adaptations for coping with life in almost any kind of freshwater ecosystem (de Moor and Ivanov, 2008). Annulipalpian larvae make fixed shelters and integripalpian larvae make portable tube cases from mineral or organic materials (Mackay and Wiggins, 1979; Kjer *et al.*, 2002). Spicipalpia show differing behavior: there are free-living Rhyacophilidae, "purse-case-makers" (Hydroptilidae) and "saddle-case makers" (Glossosomatidae). The larvae undergo approximately five instars before pupation and have to build a new case each time it moults (Mackay and Wiggins, 1979).

Pupation is almost always aquatic, and transformation of the last larval instar to the pupal stage takes place in a selected cocoon (pupal case) that is usually some modification of the larval retreat. Pupal cases are generally fixed to some object. The trichopteran pupa is exarate and usually possesses a pair of strong functional mandibles, non functional in the adult, and the abdomen has a number of segments adorned with characteristic sclerotised, dorsal hook-bearing plates (McCafferty, 1998; de Moor and Ivanov, 2008). Development of adult structures during the pupal stage requires approximately three weeks in most species. The individual then cuts itself free, crawls from the water or swim to the surface, and the adult emerges from the pupal skin. It is at this time, when the caddisfly is relatively exposed, that it is most vulnerable to fish predation (Williams and Feltmate, 1992 and McCafferty, 1998)

GLOBAL DIVERSITY OF TRICHOPTERA

de Moor and Ivanov (2008), studied the global diversity of caddisflies in freshwater. They found that the recently updated Trichoptera World Checklist (TWC) [http://entweb.clemson.edu/database/ trichopt/search.htm], as at July 2006, recorded 12,627 species [at June 2009, 13,574 species (Morse, 2010)]. These species are arranged in 610 genera and 46 extant families [at June 2009, 608 genera and 47 families (Morse, 2010)]. In addition, 488 species and 78 genera in seven families are known only from fossil records [at June 2009, 680 species and 127 genera and 12 families (Morse, 2010)]. New species continue to be described at a considerable rate and it seems that the prediction of Schmid (1984) and Flint *et al.* (1999), although considered an overestimate by Malicky (1993), that there are in excess of 50,000 species may be closer to the actual figure. If these estimates are correct, this leads to the assumption that only around 20–25% of the world species of Trichoptera have been described (de Moor and Ivanov, 2008).

A synthesis of the number of genera and species based on the earlier edition of the TWC (last updated 8 January 2001) reveals a total of 11,532 extant species in 620 genera and 94 sub-genera. More than half of these known species were recorded from only two regions, the Oriental and Neotropical Regions (Figure 5.1.7). The highest species diversity is recorded in the Oriental Region. With more than 3,700 species, it contains more than double the recorded species for each of the other regions, except the Neotropics. The Neotropical Region records the greatest number of species in the families Hydroptilidae and Glossosomatidae. There are no Rhyacophilidae in this region but Hydrobiosidae, confined mostly to southern Patagonia and Chile, are second in species richness after the Australian Region. The West Palaearctic Region records the greatest number of integripalpian species in the families Limnephilidae, Sericostomatidae and Beraeidae (de Moor and Ivanov, 2008).

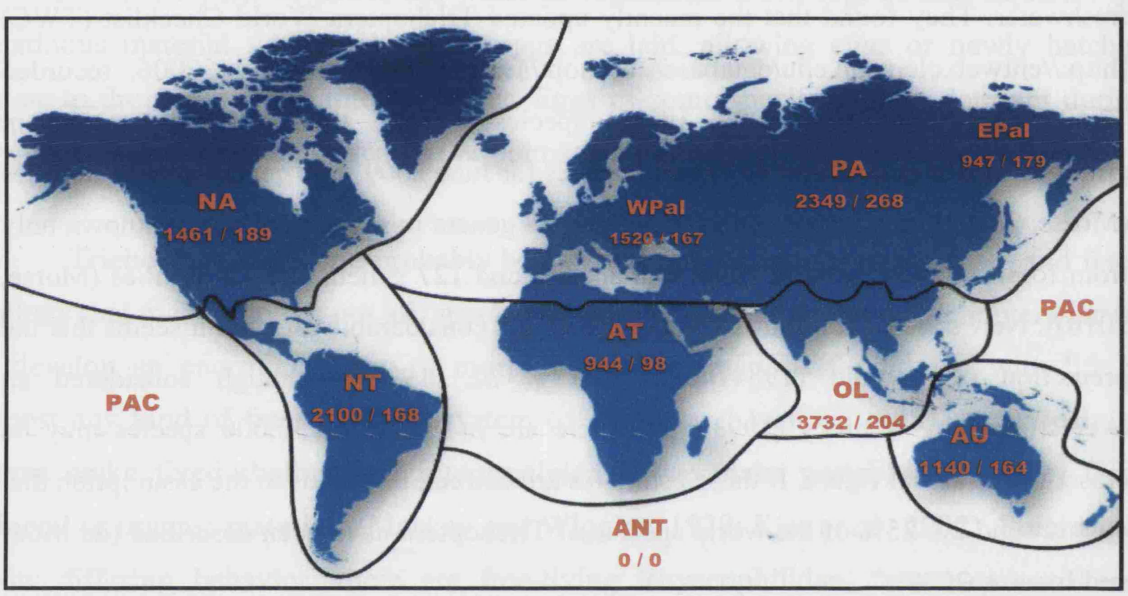


Figure (5.1.7): Trichoptera diversity: number of species/number of genera plus subgenera per realm. AT: Afrotropical; numbers for AU: Australasian include Pacific Oceanic Islands (PAC); PA (WPal): West Palaearctic; PA (EPal): East Palaearctic; NA: Nearctic; NT: Neotropical; OL: Oriental (After de Moor and Ivanov, 2008).

ORDER: TRICHOPTERA KIRBY, 1813

Family: Hydroptilidae Stephens, 1836

Orthotrichia angustella (McLachlan, 1865)

General distribution: European and North African species. It is widely distributed in theIberian Peninsula. It was recorded in Madrid by Schmid (1952).

Preferred habitat: Usually live in lentic water and at margins of lakes, where it found on the stone surfaces covered with algae. In rivers it has been found in midstream reaches at lower altitude.

Localization in the study area: Larva of this species was recorded once in Camping Lagos and represented by a single individual.

Previous records: This is the first record of this species in the Park.

Family: Ecnomidae Ulmer, 1903

Ecnomus deceptor McLachlan, 1884

General distribution: This species is known in the western Mediterranean area. In the Iberian Peninsula, it is widely distributed but not present in north-western area. It was recorded in Madrid by Prieto and García de Jalón (1987).

Preferred habitat: The larvae live at the margins of streams and lakes and also have been found in estuaries. It is able to tolerate high salinities and it can also be present in quite eutrophic waters.

Localization in the study area: Larvae of this species were recorded in 5 wetlands, El Campillo 1, Las Madres 1, Las Madres 3, Muñoz and Villafranca.

Previous records: This is the first record of this species in the Park.

5.2

ECOLOGY

5.2. ECOLOGY

5.2.1. AQUATIC MACROINVERTEBRATE COMMUNITY COMPOSITION IN THE SOUTHEAST REGIONAL PARK

In this study, aquatic insects only were identified to genus/species level (except for Diptera which identified to family-level) and the rest of aquatic macroinvertebrates were identified to the lowest practical taxonomic level. The numeric taxonomic composition of the collected macroinvertebrates was: 9 classes, 13 orders, 51 families, 64 genera and 88 species. The number of individuals of these orders and their respective families, genera and species is illustrated in Appendix 3.

In our presentation of the results, we will take into account only the samples collected during October 1998 and February, May and July 1999. Also, we will take into account 11 taxonomic groups only; Tricladida, Oligochaeta, Rhynchobdellida, Decapoda, Trombidiformes, Ephemeroptera, Odonata, Heteroptera, Coleoptera, Trichoptera and Diptera. Macroinvertebrates represented by presence/absence or missed in some months will be excluded (as Hydroida, Mollusca and Ostracoda).

During October 1998 and February, May and July 1999, we counted a total of 74970 aquatic macroinvertebrate individuals from 371 replicas, from different habitats, vegetated and non- vegetated. As shown in Table (5.2.1) a total of 11 macroinvertebrate groups (10 orders and a single group of macroinvertebrates, Oligochaeta, identified to class level), were collected from non-vegetated and vegetated habitats (with cattails, reeds and charophytes). In general, insects dominated the assemblage, either in the number of different taxa identified (104 from 110 taxa collected from the Park, i.e. 94.5 %) orquantitatively (69015 from 74970 individuals, i.e. 92%) (Appendix 3).

Table (5.2.1): Aquatic macroinvertebrate groups associated with reeds, cattails, charophytes and non-vegetated habitats in the study stations of the Southeast Regional Park during the study period.

[redacted]															
Henares River Dam 1	7	Cattails	0	110	0	2	0	6	25	3	18	0	2216	2380	3778
		Non-vegetated	0	366	0	3	0	1	9	52	2	0	965	1398	
[redacted]															
Rivas1	13	Non-vegetated	0	0	0	0	0	1	109	3	29	0	645	787	787
[redacted]															
El Campillo 1	35	Reeds	0	125	48	0	84	113	101	189	32	1	1465	2158	8096
		Cattails	0	139	20	0	29	89	204	1052	16	0	1956	3505	
		Non-vegetated	0	69	10	0	6	88	159	1451	0	0	650	2433	
[redacted]															
Las Madres 1	49	Cattails	1	43	0	42	1	175	217	45	2	1	955	1482	1955
		Non-vegetated	0	91	0	21	3	131	18	54	0	8	147	473	
[redacted]															
Camping Lagos 1	55	Reeds	0	45	0	24	7	18	131	21	0	0	273	519	2384
		Non-vegetated	0	314	0	7	0	319	18	634	1	1	571	1865	
[redacted]															
Villafranca	58	Reeds	0	21	0	34	2	217	218	3	2	0	937	1434	2171
		Non-vegetated	0	3	0	1	5	36	10	7	0	1	674	737	
[redacted]															
San Martin de la Vega 7	92	Cattails	0	321	0	2	0	34	188	175	17	0	3490	4227	4227
[redacted]															
Ciempozuelos 1	104	Reeds	0	347	0	14	0	17	36	223	22	0	1067	1726	6149
		Cattails	0	57	0	1	0	1	41	30	4	0	1529	1663	
		Non-vegetated	0	102	33	0	0	5	2	1207	2	0	1409	2760	
[redacted]															
Los Frailes	118	Cattails	0	341	0	0	2	5	23	36	70	0	842	1319	1319
[redacted]															

Regarding the total macroinvertebrate community composition in the Southeast Regional Park and their relation to habitat types (vegetated or non-vegetated) (Table 5.2.2 and Figure 5.2.1), it was found that the habitats vegetated with cattails supported the highest macroinvertebrate abundance (223 individuals/0.3 m^2), followed by charophytes (209 individuals/0.3 m^2), non-vegetated habitats (206 individuals/0.3 m^2) and reeds (160 individuals/0.3 m^2). On the other hand, the highest taxa richness was recorded in the habitats vegetated with cattails (70% of total taxa richness) followed by non-vegetated habitats, reeds and charophytes with 67, 43 and 14% of total taxa richness.

The average abundance (individuals/0.3 m^2) of macroinvertebrate groups in relation to habitat types is shown in Figure (5.2.2a-k). Diptera appears to have greater abundance in habitats vegetated with cattails (160 individuals/0.3 m^2), followed by reeds (118 individuals/0.3 m^2), non-vegetated habitats (112 individuals/0.3 m^2) and finally charophytes with about 41 individuals/0.3 m^2. Heteroptera community appears to mainly occur in the non-vegetated habitats with about 48 individuals/0.3 m^2. Ephemeroptera community appears to occur mainly in the non-vegetated habitats with about 143 individuals/0.3 m^2. Odonata appears associated with cattails and reeds with about 18 and 10 individuals/0.3 m^2, respectively. Coleoptera appears to have greater abundance in the non-vegetated habitats (10 individuals/0.3 m^2). Concerning oligochaetes, they appear mainly abundant in the non-vegetated habitats (15 individuals/0.3 m^2), followed by cattails and reeds with about 14 and 11 individuals/0.3 m^2, respectively. Other macroinvertebrate groups such as Rhynchobdellida and Trombidiformes appear mainly abundant with reeds (with about 1 individuals/0.3 m^2).

Table (5.2.2): Taxa richness and average abundance/replica (individuals/0.3 m^2) of the aquatic macroinvertebrate groups collected from the Southeast regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non vegetated habitats) during the study period.

Macroinvertebrate groups	Reeds	Cattails	Charophytes	Non-vegetated habitat
Tricladida	0	1	0	0
Oligochaeta	1	1	1	1
Rhynchobdellida	1	1	0	1
Decapoda	2	2	2	2
Trombidiformes	1	1	0	1
Ephemeroptera	4	4	4	4
Odonata	11	15	4	12
Heteroptera	6	13	1	7
Coleoptera	12	27	1	33
Trichoptera	1	2	0	3
Diptera	8	10	2	10
No. of Replicas	**80**	**126**	**9**	**156**
Total Abundance	**12817**	**28145**	**1879**	**32129**
Average abundance/ Replica	**160**	**223**	**209**	**206**
Total Richness	**47**	**77**	**15**	**74**
Total Richness %	**43**	**70**	**14**	**67**

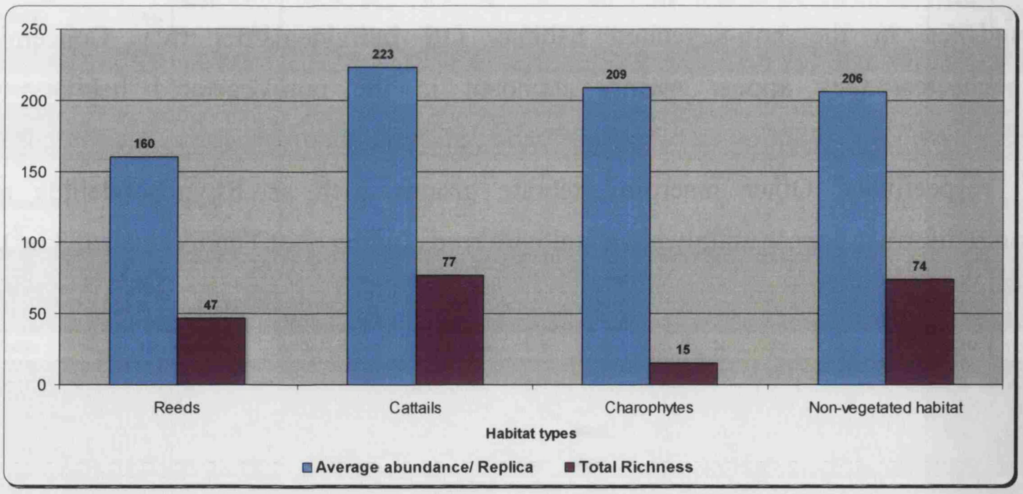


Figure (5.2.1): Taxa richness and average abundance/replica (individuals/0.3 m^2) of the aquatic macroinvertebrate groups in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

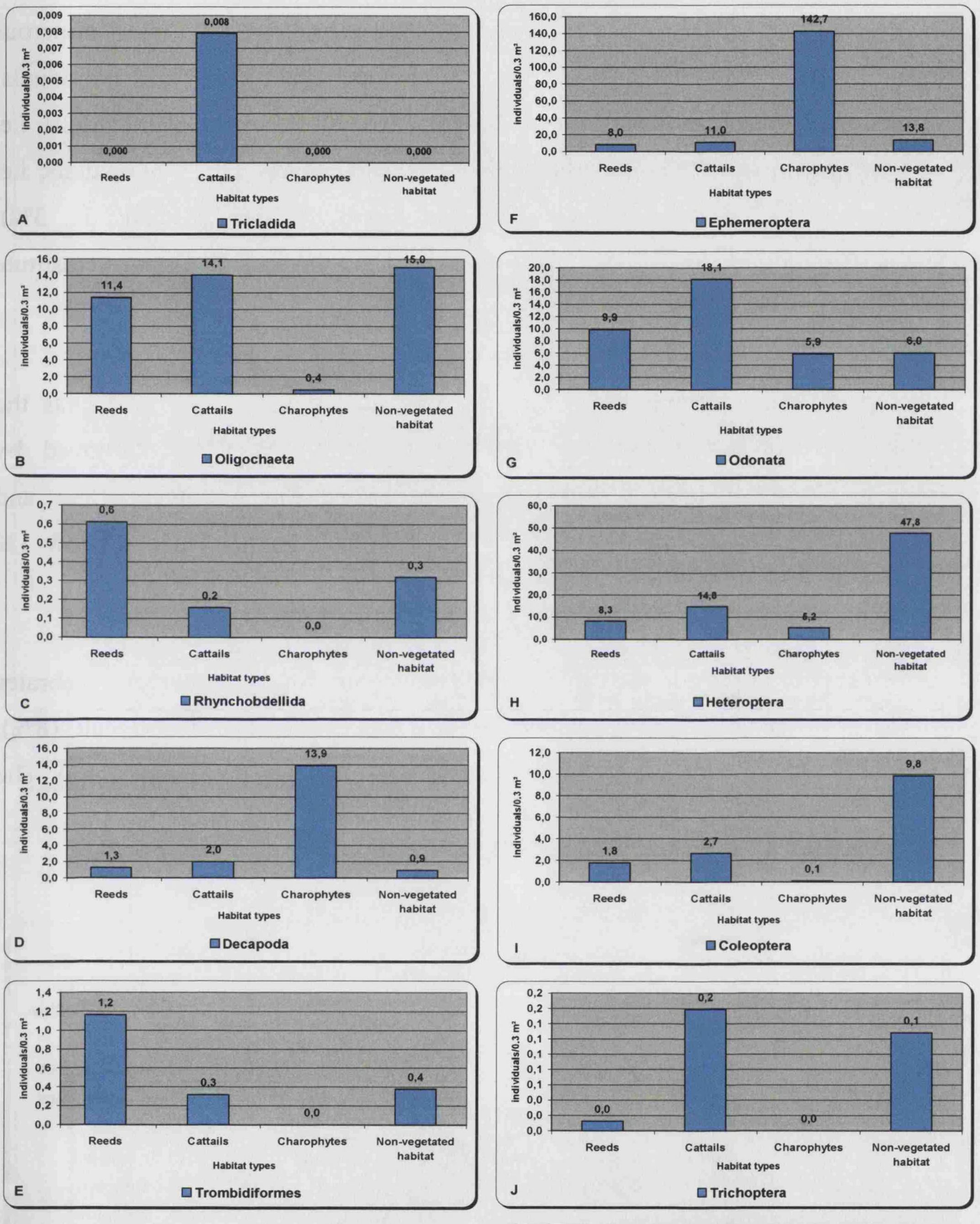
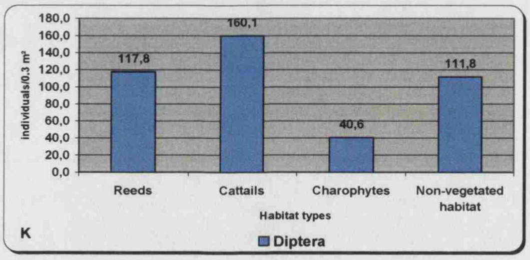


Figure (5.2.2a-k): Average abundance (individuals/0.3 m^2) of the aquatic macroinvertebrate groups collected from the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats). A: Tricladida; B: Oligochaeta; C: Rhynchobdellida; D: Decapoda; E: Trombidiformes, F: Ephemeroptera; G: Odonata; H: Heteroptera; I: Coleoptera; J: Trichoptera; K: Diptera.



As shown in Table (5.2.1) and Figure (5.2.3), Diptera was the most numerous organisms present in the Southeast Regional Park representing 63% (47391 individuals) of the total assemblage, followed in abundance by Heteroptera (10033 individuals, i.e. 13%), Ephemeroptera (5469 individuals, i.e. 7%), Oligochaeta (5023 individuals, i.e. 7%), Odonata (4067 individuals, i.e. 5%), Coleoptera (2014 individuals, i.e. 3%), Decapoda (620 individuals, i.e. 1%). The remaining macroinvertebrate groups constitute the remaining percentage.

Regarding aquatic macroinvertebrates associated with reeds, Diptera was the most numerous group representing 74% of the total assemblage, followed by Oligochaeta (7%), Odonata (6%), Heteroptera (5%), Ephemeroptera (5%) and Coleoptera (1%). The remaining groups were recorded with percentages below 1% (Figure 5.2.4a).

Diptera represented the most abundant order for the macroinvertebrates associated with cattails with a percentage of 72%, followed by Odonata (8%), Heteroptera (7%), Oligochaeta (6%), Ephemeroptera (5%) and Coleoptera (1%). The remaining groups were recorded with little values not exceed 1% (Figure 5.2.4b).

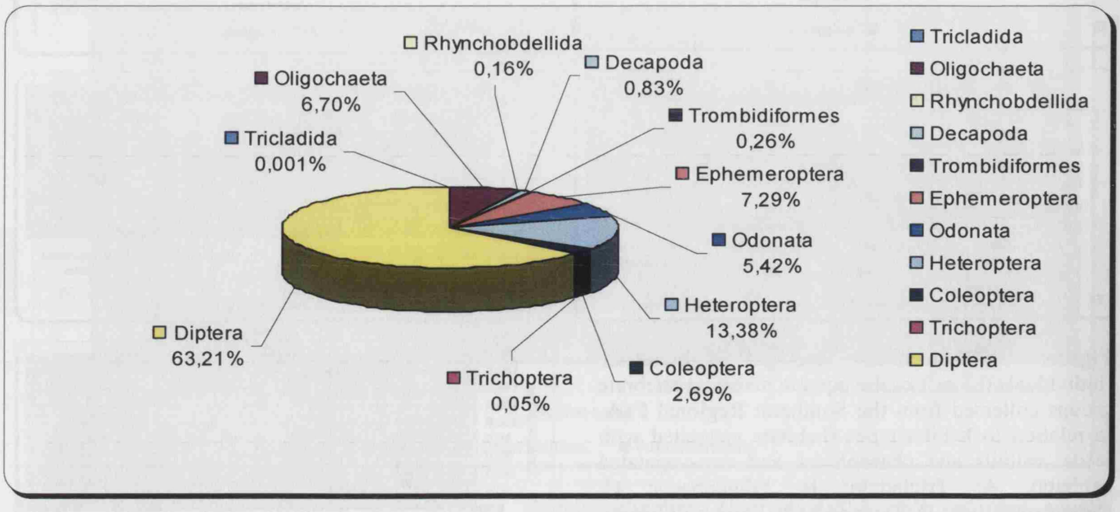


Figure (5.2.3): Percentage abundance of the main macroinvertebrate groups recorded in the Southeast Regional Park during the study period.

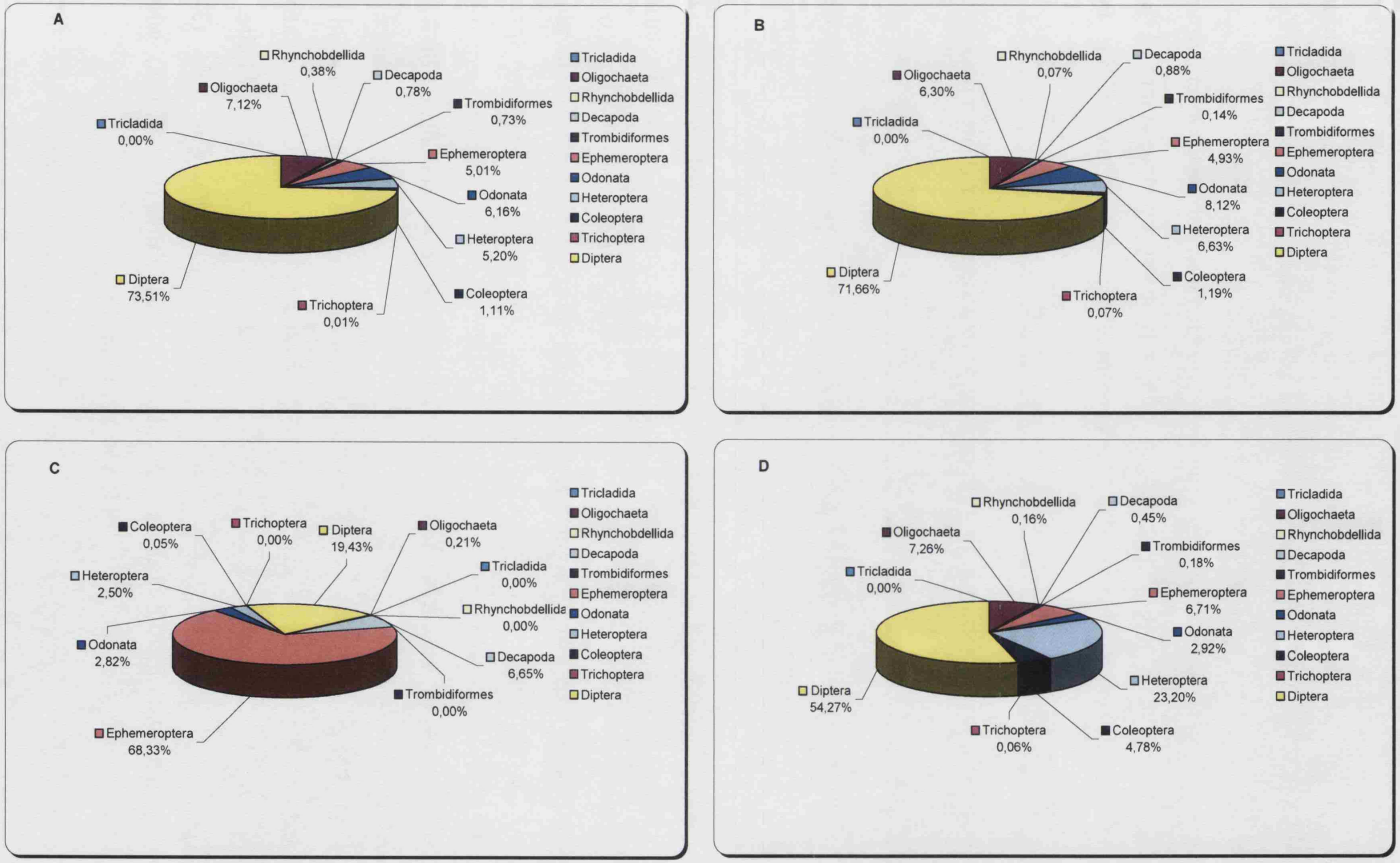


Figure (5.2.4a-d): Percentage abundance of the main macroinvertebrate groups recorded in the different habitats of the Southeast Regional Park during the study period. A, B and C: habitats vegetated with reeds, cattails and charophytes, respectively, and D: non-vegetated habitats.

Concerning aquatic macroinvertebrates associated with charophytes, Ephemeroptera was the most numerous group representing 68%, followed by Diptera (19%), Decapoda (7%), Odonata (3%) and Heteroptera (3%) (Figure 5.2.4c).Tricladida, Rhynchobdellida, Trombidiformes and Trichoptera were completely absent.

Regarding macroinvertebrates present in non-vegetated habitats, Order Diptera continued their dominance with a percentage of 54%, followed by Heteroptera (23%), Oligochaeta (7%), Ephemeroptera (7%), Coleoptera (5%) and Odonata (3%). The remaining groups were recorded with little values not exceed 1% (Figure 5.2.4d).

5.2.2. AQUATIC MACROINVERTEBRATE COMMUNITY COMPOSITION IN THE STUDY STATIONS OF THE SOUTHEAST REGIONAL PARK

As shown in Table (5.2.3) and Figure (5.2.5a-q), Diptera was the dominant order in all sampling stations except in San Antonio 5 (station 34) and Boyeriza Spring (station 84), where Heteroptera and Coleoptera were the dominant orders, respectively. The percentage abundance of Diptera was ranged from 7.30 % (160 individuals) in Boyeriza Spring (station 84) to 84% (3181 individuals) in Henares River Dam 1 (station 7). Heteroptera comprised about 43% (126 individuals) of the total number of individuals collected from San Antonio 5 (station 34) and considered the most abundant group in this station. Coleoptera was the most abundant group in Boyeriza Spring (station 84) with a percentage of 67% (1476 individuals). Ephemeroptera was completely absent from station 84, while the highest percentage abundance of 31% (2122 individuals) was recorded in Muñoz (station 57). The percentage abundance of Odonata was ranged from about 1% of the total macroinvertebrate abundance in El Porcal 9 (station 47), Henares River dam 1 (station 7) and Soto de Las Cuevas (station 104) (9, 34, and 79 individuals, respectively) to 17% (620 individuals) in Las Madres 3 (station 51). The highest percentage abundance of Oligochaeta was 26% (341 individuals) of the total macroinvertebrate abundance in Los Frailes (station 118), while Oligochaeta was completely absent from Rivas 1 (station 13).

Table (5.2.3): Aquatic macroinvertebrate community composition in the study stations of the Southeast Regional Park during the study period.

Station	Code	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Henares River Dam 1	7	0	476	0	5	0	7	34	55	20	0	3181	3778
Henares River Dam 2	8	0	100	0	62	5	1020	725	106	[illegible]	0	4514	[illegible]
Rivas1	13	0	0	0	0	0	1	109	3	29	0	645	787
San Antonio 5	34	0	9	0	0	0	60	11	126	28	0	68	[illegible]
El Campillo 1	35	0	333	78	0	119	290	464	2692	48	1	4071	8096
El Porcal 9	47	0	67	0	3	0	1	9	426	13	0	810	1329
Las Madres 1	49	1	134	0	63	4	306	235	99	2	9	1102	1955
Las Madres 3	51	0	157	0	160	46	416	620	[illegible]	[illegible]	12	2240	[illegible]
Camping Lagos 1	55	0	359	0	31	7	337	149	655	1	1	844	2384
Muñoz	57	0	68	0	232	0	2122	359	98	3	17	[illegible]	[illegible]
Villafranca	58	0	24	0	35	7	253	228	10	2	1	1611	2171
Boyeriza Spring	84	0	406	0	0	2	0	144	2	1476	0	160	2190
San Martín de la Vega 7	92	0	321	0	2	0	34	188	175	17	0	3490	4227
Tierno Galván Park	93	0	344	8	1	0	44	64	172	3	0	1933	2569
Ciempozuelos 1	104	0	506	33	15	0	23	79	1460	28	0	4005	6149
Soto de las Cuevas	107	0	1378	0	11	0	550	625	3659	242	0	[illegible]	[illegible]
Los Frailes	118	0	341	0	0	2	5	23	36	70	0	842	1319
	Total	1	5023	119	820	192	5408	[illegible]	[illegible]	[illegible]	41	[illegible]	

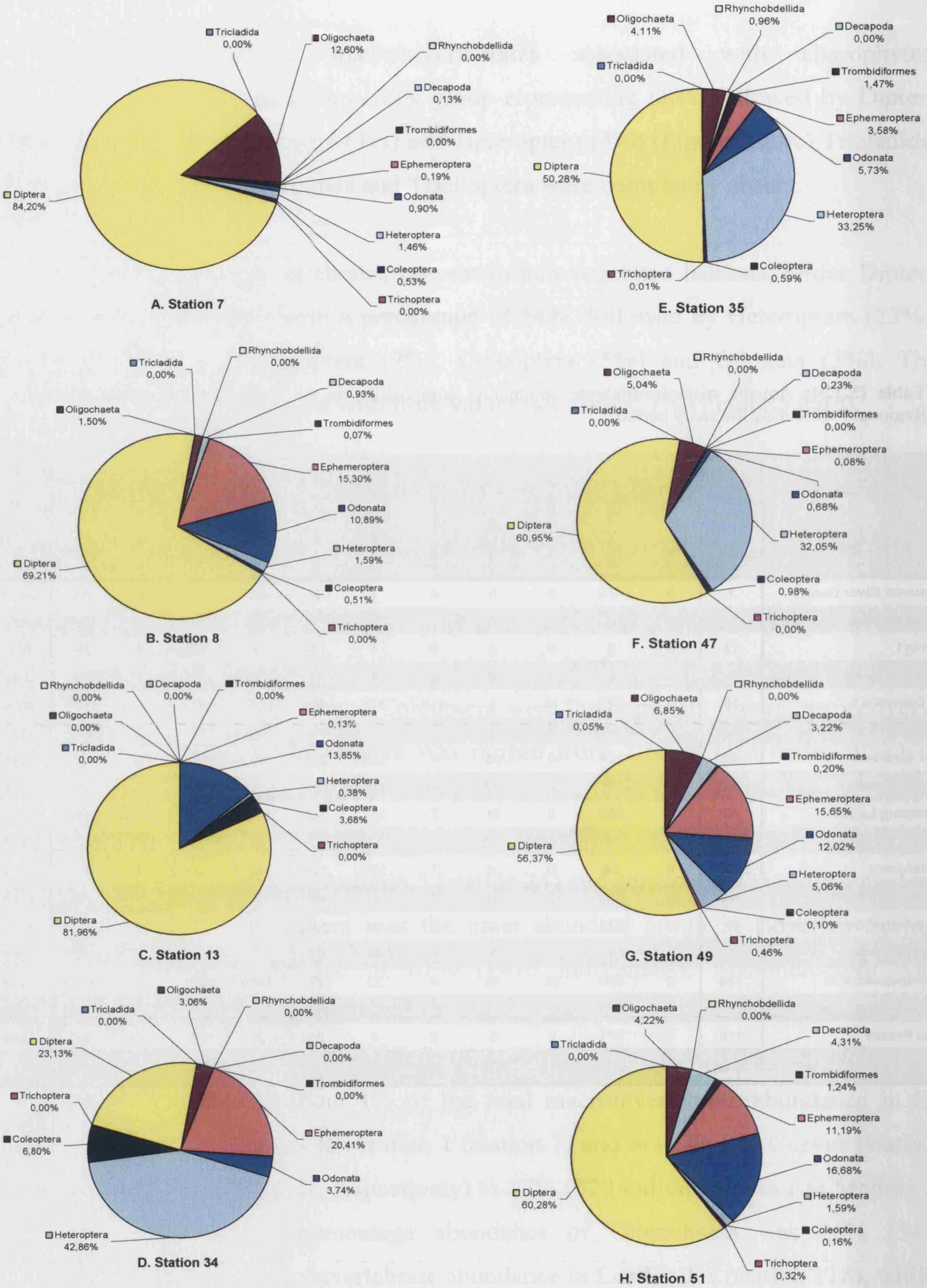
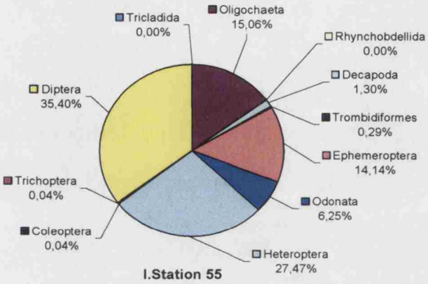
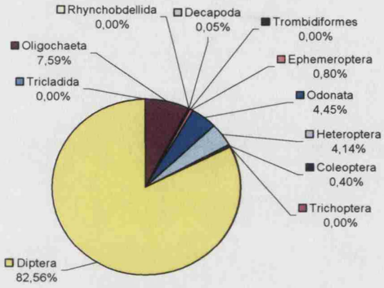


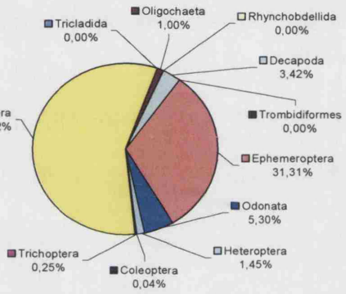
Figure (5.2.5a-q): Aquatic macroinvertebrate community composition in the study stations of the Southeast Regional Park during the study period. A: Station 7; B: Station 8; C: Station 13; D: Station 34; E: Station 35; F: Station 47; G: Station 49; H: Station 51; I: Station 55; J: Station 57; K: Station 58; L: Station 84; M: Station 92; N: Station 93; O: Station 104; P: Station 107; Q: Station 118.



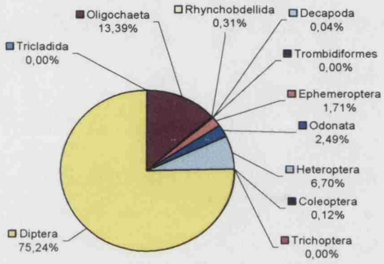
I.Station 55



M. Station 92



J. Station 57



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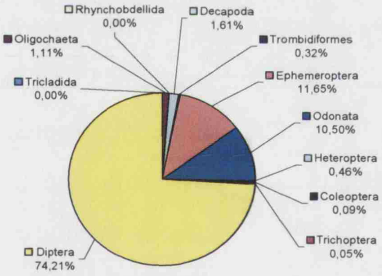
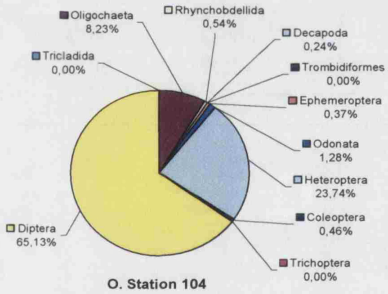
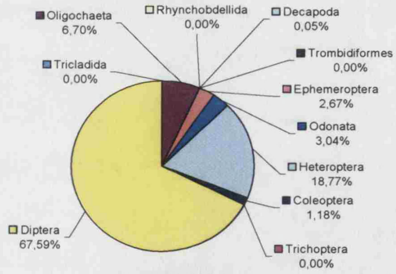


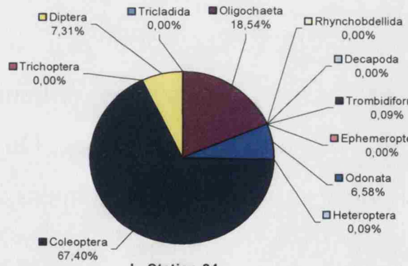
K. Station 58



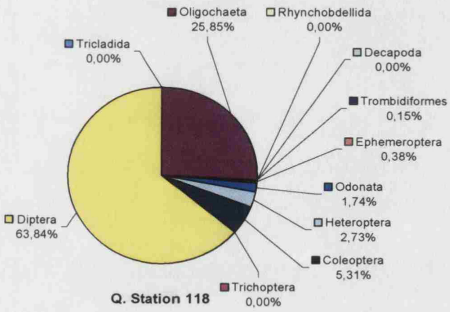
O. Station 104



P. Station 107



L. Station 84



Q. Station 118

Continued, Figure (5.2.5a-q)

5.2.3. ABUNDANCE, RICHNESS, SHANNON DIVERSITY, EVENNESS, JACCARD SIMILARITY AND % CHIRONOMIDAE

The average abundance (individuals/0.3 m^2) of benthic macroinvertebrates, taxa richness, Shannon diversity, evenness and %Chironomidae were calculated for each sampling station within the Southeast Regional Park (Table, 5.2.4).

Regarding the average abundance, the highest numbers of individuals were recorded in Soto de Las Cuevas (stations 107) (571 individuals/0.3 m^2), followed by Boyeriza Spring (station 84) and San Martín de la Vega (station 92) with about 365 and 352 individuals/0.3 m^2, respectively. On the other hand, the lowest numbers of individuals were recorded in San Antonio 5 (station 34) and El Porcal 9 (station 47) with about 49 and 55 individuals/0.3 m^2, respectively (Figure 5.2.6). Taxa richness was ranged from 16 (14.5%) to 36 taxa (32.7%). The lowest taxa richness was observed in Henares River Dam 1 (station 7) and Tierno Galván Park (station 93), while the highest taxa richness was observed in Boyeriza Spring (station 84) and Soto de Las Cuevas (station 107). Shannon diversity index values were varied among the study stations. The highest value of 2.69 was recorded in Boyeriza Spring (station 84), while the lowest value of 0.96 was recorded in Henares River Dam1 (station 7). Taxa evenness was ranged from 0.24 (Henares River Dam 1; station 7) to 0.6 (Muñoz; station 57). Station 7 (Henares River Dam 1) has the highest percentage of Chironomidae (82.56%), while the lowest percentage of 3.84% was recorded in station 84 (Boyeriza Spring). In brief, Henares River Dam 1 (station 7) has the lowest values of taxa richness, Shannon diversity index and evenness, while has the highest percentage of Chironomidae. On the other hand, Boyeriza Spring (station 84) has the highest values of taxa richness and Shannon diversity index, while has the lowest percentage of Chironomidae.

Table (5.2.5) lists the biological indices for macroinvertebrate communities in the different habitat types, either vegetated (with cattails, reeds and charophytes) or non-vegetated. It was clearly that the non-vegetated habitat of Soto de Las Cuevas (station 107) has the highest average abundance of macroinvertebrates (866 individuals/0.3 m^2).

Very low average abundance values (not exceed 43 individuals/0.3 m^2) were recorded in the non-vegetated habitats of El Porcal (station 47) and Las Madres 1 (station 49), and in the habitats vegetated with reeds in San Antonio 5 (station 34) and Camping Lagos (station 55) (Figure 5.2.7). The highest two values of taxa richness 36 (32.7%) and 34 taxa (30.9%) were recorded in the non-vegetated habitats of Boyeriza Spring (station 84) and in the habitats vegetated with cattails in Los Frailes (station 118), respectively. The lowest values of 4 - 8 taxa (3.6 - 7.3%) were recorded in the non-vegetated habitats of El Porcal (station 47) and San Antonio 5 (station 34), and habitats vegetated with reeds in Tierno Galván Park (station 93). The highest two values of Shannon diversity (2.69 and 2.68) were recorded in the non-vegetated habitat of Boyeriza Spring (station 84) and in the habitat vegetated with cattails in Las Madres 3 (station 51), respectively. On the other hand, the lowest two values (0.61 and 0.62) were recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104), respectively. The highest value of taxa evenness (0.69) was recorded in the non-vegetated habitat of Las Madres 1 (station 49), while the lowest value was recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104). The highest percentage abundance values of Chironomidae (91.5 and 91.6 %) were recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104), respectively. The lowest percentage abundance of Chironomidae (3.8%) was recorded in the non-vegetated habitat of Boyeriza Spring (station 84).

As shown in Table (5.2.6), the similarity in taxa composition among the study stations was analyzed using the Jaccard Index for calculating the extent of similarity between pairs of data sets. The Jaccard Index value between Las Madres 1 (station 49) and Las Madres 3 (station 51) was the highest, while it was the lowest for the comparison between Boyeriza Spring (station 84) and Muñoz (station 57). Very low similarity index values $\leq$ 0.130) were recorded between station 84 (Boyeriza Spring) and stations 55 (Camping Lagos 1), 13 (Rivas 1), 93 (Tierno Galván Park) and 34 (San Antonio 5), also between station 13 (Rivas 1) and 34 (San Antonio 5). On the other hand, High similarity index values $\geq$ 0.5) were recorded between stations 7 (Henares

River Dam 1) and 92 (San Martín de la Vega), 55 (Camping Lagos 1) and 93 (Tierno Galván Park), 55 (Camping Lagos 1) and 57 (Muñoz), 8 (Henares River Dam 2) and 35 (El Campillo), 49 (Las Madres 1) and 57 (Muñoz), 55 (Camping Lagos 1) and 58 (Villafranca) and 57 (Muñoz) and 58 (Villafranca). The similarity in taxa composition across stations is shown as a dendrogram in Figure (5.2.8), obtained from the Jaccard Index of similarity using the average linkage method.

Table (5.2.4): Summary statistics of abundance, richness, evenness, Shannon diversity and %Chironomidae of the aquatic macroinvertebrates of the Southeast Regional Park during the study period.

Station	Code	Average abundance (indiv./ 0,3 m²)	Taxa richness	Shannon Diversity Index	Evenness	Total abundance of chironomids	% Chironomidae
Henares River Dam 1	7	157,4	16	0,96	0,24	3119	82,56
Henares River Dam 2	8	317,5	32	1,64	0,33	4573	68,59
Rivas1	13	87,4	19	1,70	0,40	518	65,82
San Antonio 5	34	49,0	17	2,34	0,57	64	21,77
El Campillo 1	35	224,9	33	2,02	0,40	4015	49,59
El Porcal 9	47	55,4	18	1,41	0,34	801	60,27
Las Madres 1	49	81,5	23	2,60	0,57	1025	52,43
Las Madres 3	51	177,0	28	2,45	0,51	2116	56,94
Camping Lagos 1	55	99,3	19	2,41	0,57	825	34,61
Muñoz	57	150,6	22	2,66	0,60	2314	34,14
Villafranca	58	90,5	23	1,90	0,42	1485	68,40
Boyeriza Spring	84	365,0	36	2,69	0,52	84	3,84
San Martín de la Vega 7	92	352,3	26	1,23	0,26	3419	80,88
Tierno Galván Park	93	151,1	16	1,29	0,32	1932	75,20
Ciempozuelos 1	104	170,8	29	1,50	0,31	3971	64,58
Soto de las Cuevas	107	571,2	36	1,66	0,32	13790	67,07
Los Frailes	118	219,8	34	1,87	0,37	798	60,50

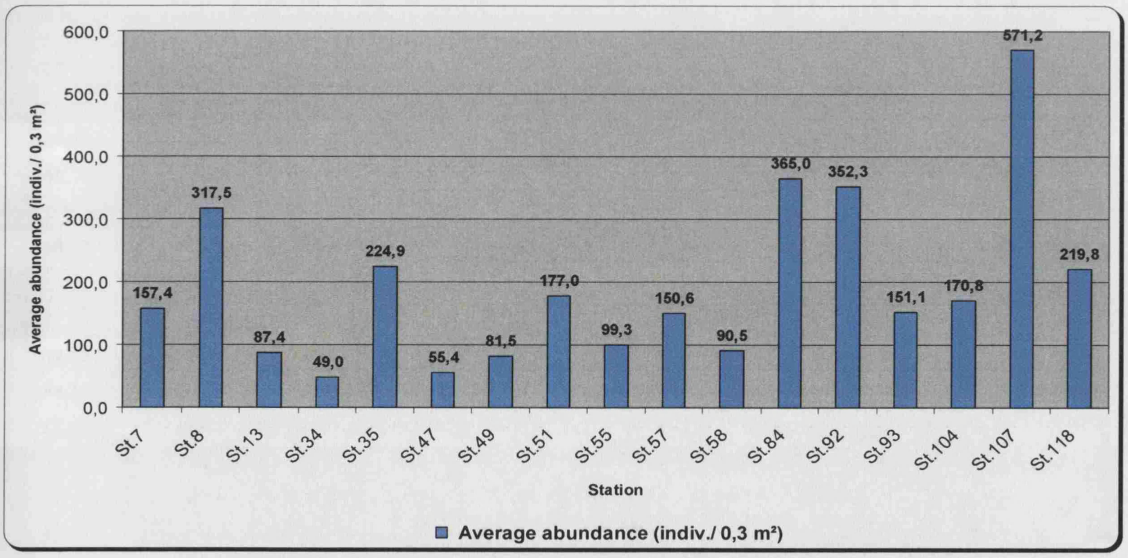


Figure (5.2.6): Average abundance (individuals/0.3 m^2) of the aquatic macroinvertebrates in the study stations of the Southeast Regional Park during the study period.

Table (5.2.5): Summary statistics of abundance, richness, evenness, Shannon diversity and %Chironomidae of the aquatic macroinvertebrates of the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

Station	Code	Habitat types	Average abundance (indiv./ 0,3 m²)	Taxa richness	Shannon Diversity Index	Evenness	Total abundance of chironomids	% Chironomidae
Henares River Dam 1	7	Cattails	198,3	15	0,61	0,16	2178	91,51
		Non-vegetated	116,5	11	1,26	0,37	941	67,31
Henares River Dam 2	8	Cattails	309,3	30	1,86	0,38	2154	58,03
		Non-vegetated	328,3	16	1,16	0,29	2419	81,86
Rivas1	13	Non-vegetated	87,4	19	1,70	0,40	518	65,82
San Antonio 5	34	Reeds	39,3	14	2,44	0,64	29	24,58
		Non-vegetated	58,7	7	1,68	0,60	35	19,89
El Campillo 1	35	Reeds	179,8	22	1,99	0,45	1453	67,33
		Cattails	292,1	25	1,90	0,41	1916	54,66
		Non-vegetated	202,8	15	1,64	0,42	646	26,55
El Porcal 9	47	Cattails	93,7	17	1,36	0,33	742	66,01
		Non-vegetated	17,1	4	1,25	0,62	59	28,78
Las Madres 1	49	Cattails	123,5	23	2,33	0,52	879	59,31
		Non-vegetated	39,4	14	2,63	0,69	146	30,87
Las Madres 3	51	Cattails	139,3	27	2,68	0,56	816	48,83
		Non-vegetated	227,2	17	2,11	0,52	1300	63,57
Camping Lagos 1	55	Reeds	43,3	16	2,46	0,62	256	49,33
		Non-vegetated	155,4	12	2,08	0,58	569	30,51
Muñoz	57	Reeds	103,3	14	2,09	0,55	767	61,90
		Charophytes	208,8	15	2,34	0,60	354	18,84
		Cattails	100,5	18	2,06	0,49	787	65,26
		Non-vegetated	204,4	16	1,97	0,49	406	16,55
Villafranca	58	Reeds	119,5	19	2,19	0,52	841	58,65
		Non-vegetated	61,4	16	0,94	0,24	644	87,38
Boyeriza Spring	84	Non-vegetated	365,0	36	2,69	0,52	84	3,84
San Martín de la Vega 7	92	Cattails	352,3	26	1,23	0,26	3419	80,88
Tierno Galván Park	93	Reeds	263,2	8	0,65	0,22	1171	88,98
		Non-vegetated	104,4	14	1,69	0,44	761	60,73
Ciempozuelos 1	104	Reeds	143,8	19	1,72	0,40	1061	61,47
		Cattails	138,6	16	0,62	0,16	1524	91,64
		Non-vegetated	230,0	12	1,38	0,38	1386	50,22
Soto de las Cuevas	107	Reeds	358,9	21	1,21	0,28	3542	82,24
		Cattails	488,0	31	1,57	0,32	4406	75,24
		Non-vegetated	866,6	18	1,49	0,36	5842	56,18
Los Frailes	118	Cattails	219,8	34	1,87	0,37	798	60,50

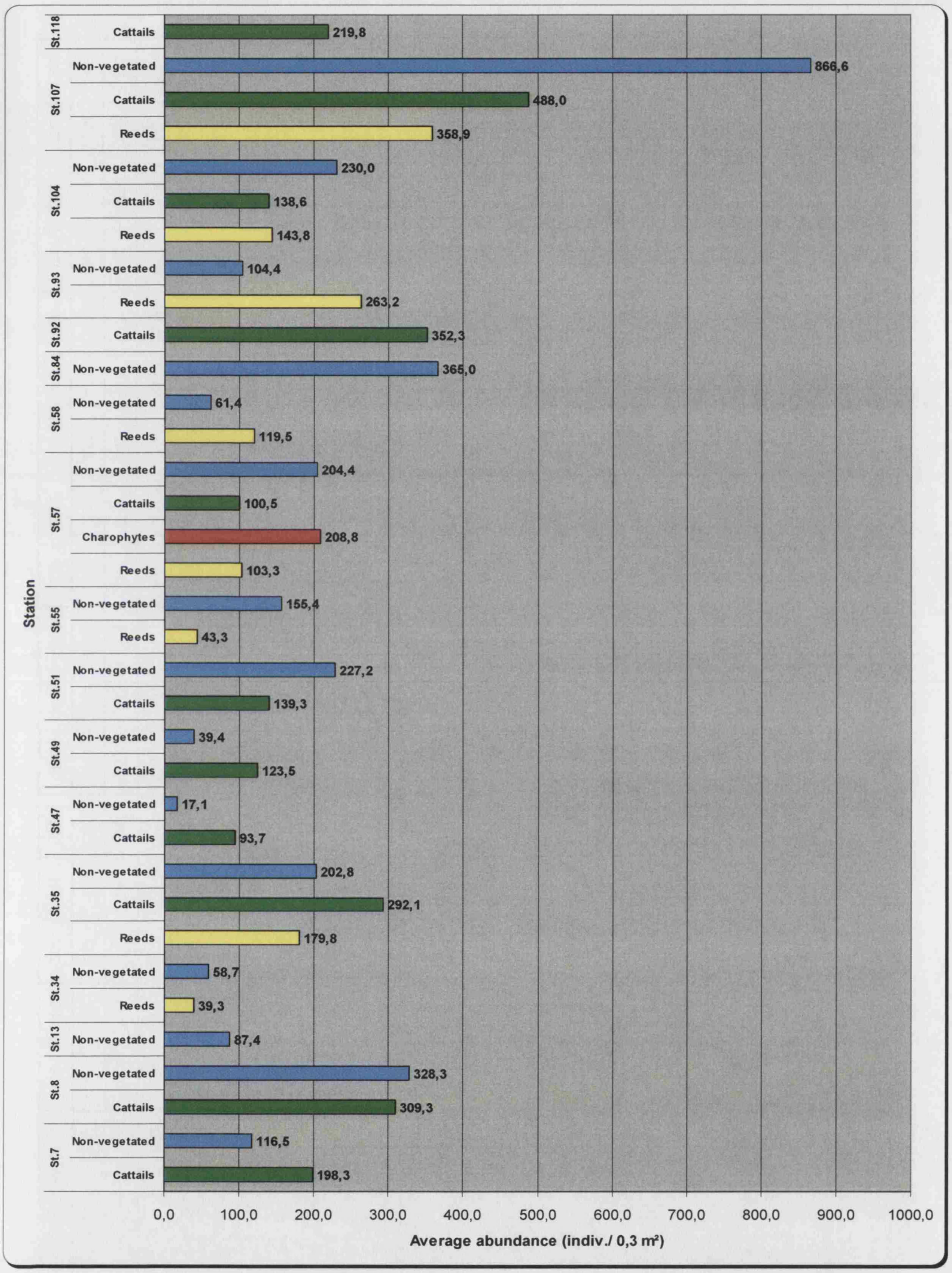


Figure (5.2.7): Average abundance (individuals/0.3 m^2) of the aquatic macroinvertebrates in the study stations of the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

Table (5.2.6): Matrix of Jaccard's similarity between the study stations of the Southeast Regional Park.

Distance matrix

Station		Ciempozuelos 1	Soto de las Cuevas	Los Frailes	Rivas1	San Antonio 5	El Campillo 1	El Porcal 9	Las Madres 1	Las Madres 3	Camping Lagos 1	Muñoz	Villafranca	Henares River Dam 1	Boyeriza Spring	Henares River Dam 2	San Martín de la Vega 7	Tierno Galván Park
	Code	St.104	St.107	St.118	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.7	St.84	St.8	St.92	St.93
Ciempozuelos 1	St.104	1,000	,383	,313	,333	,211	,409	,424	,300	,357	,371	,378	,444	,324	,226	,326	,341	,406
Soto de las Cuevas	St.107	,383	1,000	,346	,196	,178	,408	,286	,311	,362	,279	,261	,283	,268	,161	,360	,292	,300
Los Frailes	St.118	,313	,346	1,000	,233	,186	,426	,238	,213	,216	,233	,217	,213	,190	,296	,375	,250	,250
Rivas1	St.13	,333	,196	,233	1,000	,125	,238	,233	,167	,205	,226	,242	,235	,250	,122	,244	,184	,296
San Antonio 5	St.34	,211	,178	,186	,125	1,000	,163	,250	,212	,216	,241	,182	,290	,320	,128	,167	,229	,320
El Campillo 1	St.35	,409	,408	,426	,238	,163	1,000	,342	,400	,452	,405	,375	,400	,289	,211	,512	,341	,400
El Porcal 9	St.47	,424	,286	,238	,233	,250	,342	1,000	,323	,314	,423	,333	,323	,417	,227	,316	,333	,417
Las Madres 1	St.49	,300	,311	,213	,167	,212	,400	,323	1,000	,594	,448	,500	,484	,345	,157	,410	,400	,393
Las Madres 3	St.51	,357	,362	,216	,205	,216	,452	,314	,594	1,000	,424	,471	,457	,375	,185	,395	,317	,333
Camping Lagos 1	St.55	,371	,279	,233	,226	,241	,405	,423	,448	,424	1,000	,519	,500	,400	,122	,417	,324	,522
Muñoz	St.57	,378	,261	,217	,242	,182	,375	,333	,500	,471	,519	1,000	,500	,357	,094	,350	,371	,407
Villafranca	St.58	,444	,283	,213	,235	,290	,400	,323	,484	,457	,500	,500	1,000	,444	,180	,447	,400	,393
Henares River Dam 1	St.7	,324	,268	,190	,250	,320	,289	,417	,345	,375	,400	,357	,444	1,000	,209	,371	,556	,455
Boyeriza Spring	St.84	,226	,161	,296	,122	,128	,211	,227	,157	,185	,122	,094	,180	,209	1,000	,259	,216	,130
Henares River Dam 2	St.8	,326	,360	,375	,244	,167	,512	,316	,410	,395	,417	,350	,447	,371	,259	1,000	,381	,333
San Martín de la Vega 7	St.92	,341	,292	,250	,184	,229	,341	,333	,400	,317	,324	,371	,400	,556	,216	,381	1,000	,355
Tierno Galván Park	St.93	,406	,300	,250	,296	,320	,400	,417	,393	,333	,522	,407	,393	,455	,130	,333	,355	1,000

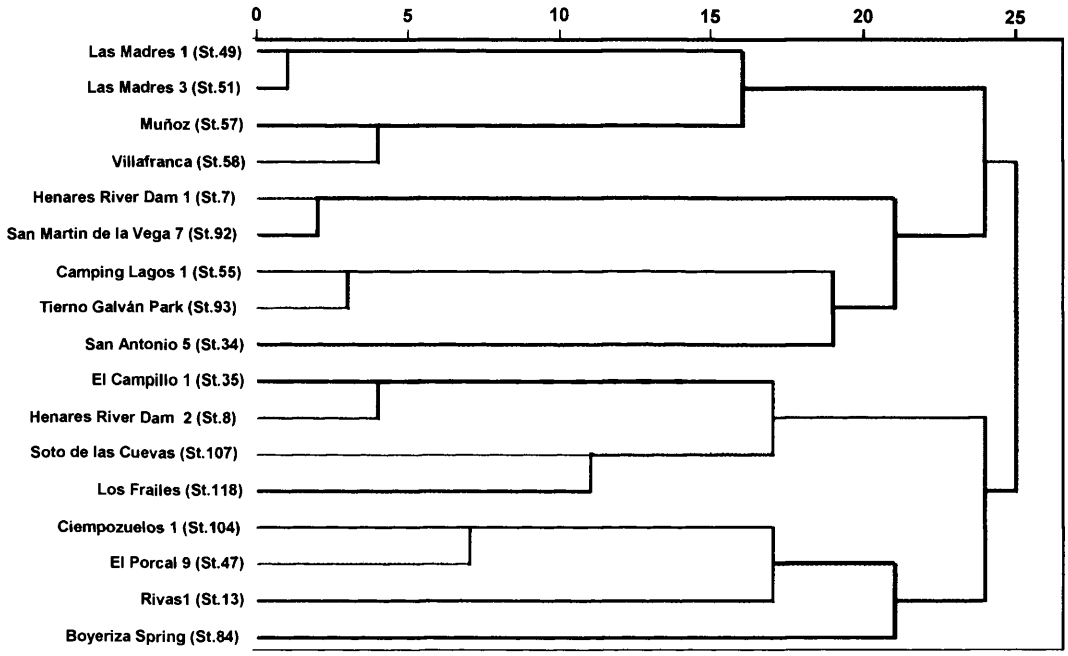


Figure (5.2.8): Dendrogram using average linkage between groups showing similarity in taxa composition across 17 sampling stations based on Jaccard index.

5.2.4. AQUATIC INSECT GROUPS

5.2.4.1. EPHEMEROPTERA

A total of 5469 ephemeropteran individuals from 4 taxa were identified for all the samples during the study period. The highest average abundance (49 individuals/0.3 m^2) was recorded in Henares River Dam 2 (station 8), followed by Muñoz (station 57) with about 47 individuals/0.3 m^2. Ephemeroptera was completely absent from Boyeriza Spring (station 84). Taxa richness ranged from 0 (Boyeriza Spring; station 84) to 4 taxa (Muñoz; station 57) (Table5.2.7).

Baetidae was the most abundant ephemeropteran family (3105 individuals, i.e. 56.8% of the total ephemeropteran abundance), followed by Caenidae (2364 individuals, i.e. 43.2%). Also, Baetidae was the most frequent where it was recorded in 16 stations, while Caenidae was recorded in 10 stations only. Baetidae was represented by 2 species *Cloeon inscriptum* and *Cloeon schoenemundi*. Regarding the average abundance, Baetidae appears to be mainly abundant in Henares River Dam 2 (station 8) with about 48 individuals/0.3 m^2 followed by Muñoz (station 57) with about 26 individuals/0.3 m^2) (Figure 5.2.9).

Caenidae was represented by a single species *Caenis luctuosa,* which is the most abundant ephemeropteran species within the Park, and appears to be frequent in the Park (occurs in 10 stations). *Caenis luctuosa* appears to mainly occur in Muñoz (station 57) with about 21 individuals/0.3 m^2 (Figure 5.2.9). This species appears to occur in a number of habitats, but appears more abundant in non-vegetated habitats (65%) as in Camping Lagos 1 (station 55), Muñoz (station 57) and Soto de Las Cuevas (station 107). Low percentage abundance values were recorded in the habitats vegetated with charophytes, reeds and cattails (16, 10 and 9% respectively) (Figure 5.2.10).

Table (5.2.7): Ephemeropteran taxa collected from the study stations of the Southeast Regional Park during the study period.

Family	Taxa	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	Abundance %
Baetidae	Baetidae	7	1004	1	60	109	1	136	190	18	1047	185	0	33	8	11	35	3	2848	16	52,08
	Cloeon inscriptum	0	0	0	0	3	0	0	0	5	14	0	0	0	10	12	0	2	46	6	0,84
	Cloeon schoenemundi	0	13	0	0	19	0	13	34	0	119	12	0	0	0	0	1	0	211	7	3,86
Caenidae	*Caenis luctuosa*	0	3	0	0	159	0	157	192	314	942	56	0	1	26	0	514	0	2364	10	43,23
Ephemeroptera abundance		7	1020	1	60	290	1	306	416	337	2122	253	0	34	44	23	550	5	5469		
Richness		1	3	1	1	4	1	3	3	3	4	3	0	2	3	2	3	2			
No. of replicas		24	21	9	6	36	24	24	21	24	45	24	6	12	17	36	36	6			
Average abundance (individuals/0.3 m²)		0,29	48,57	0,11	10,00	8,06	0,04	12,75	19,81	14,04	47,16	10,54	0,00	2,83	2,59	0,64	15,28	0,83			

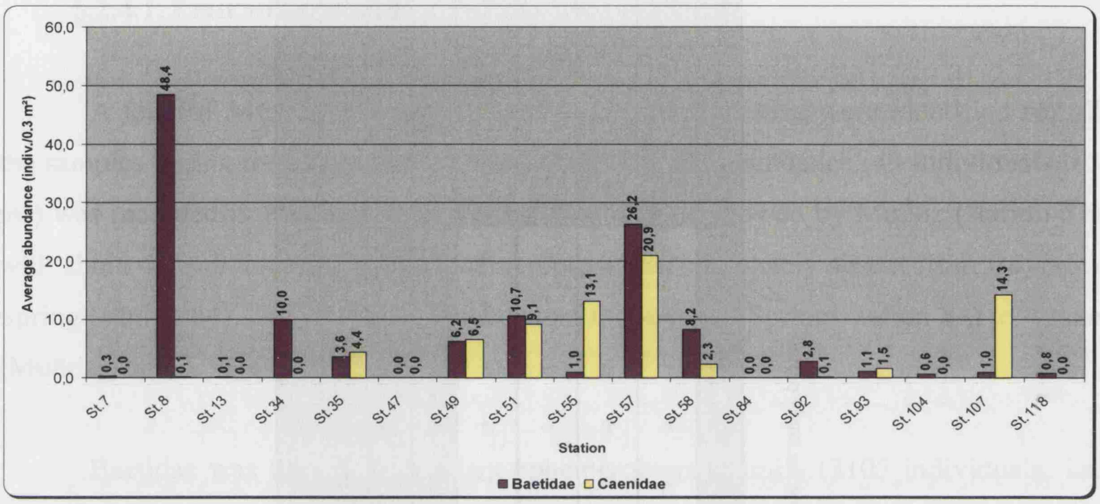


Figure (5.2.9): Average abundance (individuals/0.3 m^2) of the families of Ephemeroptera recorded in the study stations of the Southeast Regional Park during the study period.

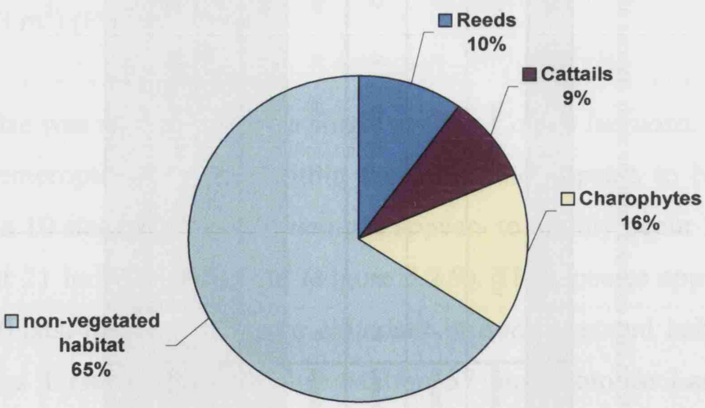


Figure (5.2.10): Total abundance of *Caenis luctuosa* recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

5.2.4.2. ODONATA

During the study period, a total of 4067 individuals from 21 taxa were identified for all the samples. Odonata was represented by 5 families, Coenagrionidae (82%), Platycnemididae (7%), Lestidae (5%), Aeshnidae (4%) and Libellulidae (2%). The highest average abundance (35 individuals/0.3 m^2) was recorded in Henares River Dam 2 (station 8), followed by Las Madres 3 (station 51) and Boyeriza Spring (station 84) with about 30 and 24 individuals/0.3 m^2, respectively. Very low average abundance values (1-2 individuals/0.3 m^2) were recorded in Henares River Dam 1 (station 7), San Antonio 5 (station 34), and El Porcal 9 (station 47). The highest richness (9 taxa) was observed in Henares River dam 2 (station 8) and Soto de Las Cuevas (station 107). On the Other hand, the lowest richness (3 taxa) was observed in Henares River Dam 1 (station 7) and San Antonio 5 (station 34) (Table 5.2.8).

Libellulidae was the most diverse family of Odonata with 5 species, while Platycnemididae was represented only by a single taxon, *Platycnemis* sp.. Coenagrionidae was represented by 3 species, and appears more abundant in Henares River Dam 2 (station 8) and Las Madres 3 (station 51) with about 33 and 27 individuals/0.3 m^2, respectively. Very low average abundance values (< 1 individuals/0.3 m^2) was observed in El Porcal 9 (station 47) and Boyeriza Spring (station 84). Platycnemididae was more abundant in Soto de Las Cuevas (station 107) with about 5 individuals/0.3 m^2, while completely absent from Henares river Dam 1 (stations 7), Rivas 1 (station 13), Muñoz (station 57), Boyeriza Spring (station 84), San Martín de La Vega 7 (station 92) and Los Frailes (station 118). Lestidae was represented by 3 species, and recorded in 4 stations only. It was mainly abundant in Boyeriza Spring (station 84) with about 23 individuals/0.3 m^2. Aeshnidae was represented by 3 species and it was recorded in all the study stations except San Antonio 5 (station 34), El Porcal 9 (station 47) and Boyeriza spring (station 84). Aeshnidae was found little abundant in the Park ($\leq$ 1 individuals/0.3 m^2). Libellulidae was represented by 6 species. Their presence was represented by few individuals (<1 individuals/0.3 m^2) and appears completely absent from 7 stations in the Park; Henares River Dam 1 (station 7), San Antonio 5 (station 24), El Porcal (station 47), Las Madres 1 (station 49), Boyeriza Spring (station 84), San Martín de la Vega 7 (station 92) and Tierno Galván Park (station 93) (Figure, 5.2.11).

Two species only were recorded in more than 4 stations in the Park (about 25% of the study stations); *Ischnura* sp. and *Platycnemis* sp.. *Ischnura* sp. was the most abundant species of Odonata within the Park (678 individuals, i.e. 16.67% of the total abundance of Odonata) and also the most frequent (recorded in all the study stations). It is more abundant in Henares River Dam 2 (station 8) with about 8 individuals/0.3 m^2, followed by Las Madres 3 (station 51) with about 6 individuals/0.3 m^2. It was associated mainly with aquatic vegetation (cattails and reeds) as in Henares River Dam 2 (station 8), Las Madres 3 (station 51), Villafranca (station 58) and Soto de Las Cuevas (station 107). *Platycnemis* sp. was by far more abundant in Soto de Las Cuevas (station 107) with about 5 individuals/0.3 m^2, and appears mainly associated with emergent cattails.

Regarding Families of Odonata and their relation to habitat types, Coenagrionidae, Platycnemididae, and Aeshnidae were associated mainly with cattails (58, 71 and 59 %, respectively). Lestidae was mainly abundant in the non-vegetated habitats (77%). Libellulidae was abundant in both non-vegetated habitats (46%) and vegetated habitats with cattails (25%) (Figure 5.2.12).

Table (5.2.8): Odonata taxa collected from the study stations of the Southeast Regional Park during the study period.

Family	Taxa	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	Abundance %
Coenagrionidae	Coenagrionidae	22	526	84	4	346	3	143	438	120	277	140	2	132	56	52	304	10	2659	17	65,38
	Ischnura sp.	10	164	6	6	44	4	40	127	11	51	61	2	45	2	10	93	2	678	17	16,67
	Erythromma lindenii	0	0	0	0	11	1	0	0	0	0	0	0	0	0	0	0	0	12	2	0,30
	Erythromma viridulum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0,02
Lestidae	Lestidae	0	2	0	0	0	0	39	3	0	0	0	90	0	0	0	0	0	134	4	3,29
	Lestes dryas	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	36	1	0,89
	Lestes viridis	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	14	1	0,34
	Sympecma sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0,05
Platycnemididae	*Platycnemis* sp.	0	3	0	1	27	1	3	34	3	0	3	0	0	4	1	195	0	275	11	6,76
Aeshnidae	Aeshnidae	2	19	5	0	31	0	10	7	3	10	20	0	10	2	13	26	2	160	14	3,93
	Aeshna mixta	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0,02
	Anax imperator	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	0,05
	Anax parthenope	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	2	0,05
	Anax sp.	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	4	2	0,10
Libellulidae	Libellulidae	0	8	11	0	2	0	0	9	11	21	2	0	0	0	1	2	6	73	10	1,79
	Crocothemis erythraea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	2	0,10
	Orthetrum cancellatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0,02
	Orthetrum sp.	0	0	3	0	0	0	0	0	0	0	1	0	0	0	1	0	0	5	3	0,12
	Selysiothemis nigra	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0,02
	Symptrum fonscolombei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	0,05
	Trithemis annulata	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0,02
Odonata abundance		34	726	109	11	464	9	235	620	149	359	228	144	188	64	79	625	23	4067		
Richness		3	9	5	3	7	4	5	8	6	4	7	5	4	4	7	9	5			
No. of replicas		24	21	9	6	36	24	24	21	24	45	24	6	12	17	36	36	6			
Average abundance (individuals/0.3 m²)		1,42	34,57	12,11	1,83	12,89	0,38	9,79	29,52	6,21	7,98	9,50	24,00	15,67	3,76	2,19	17,36	3,83			

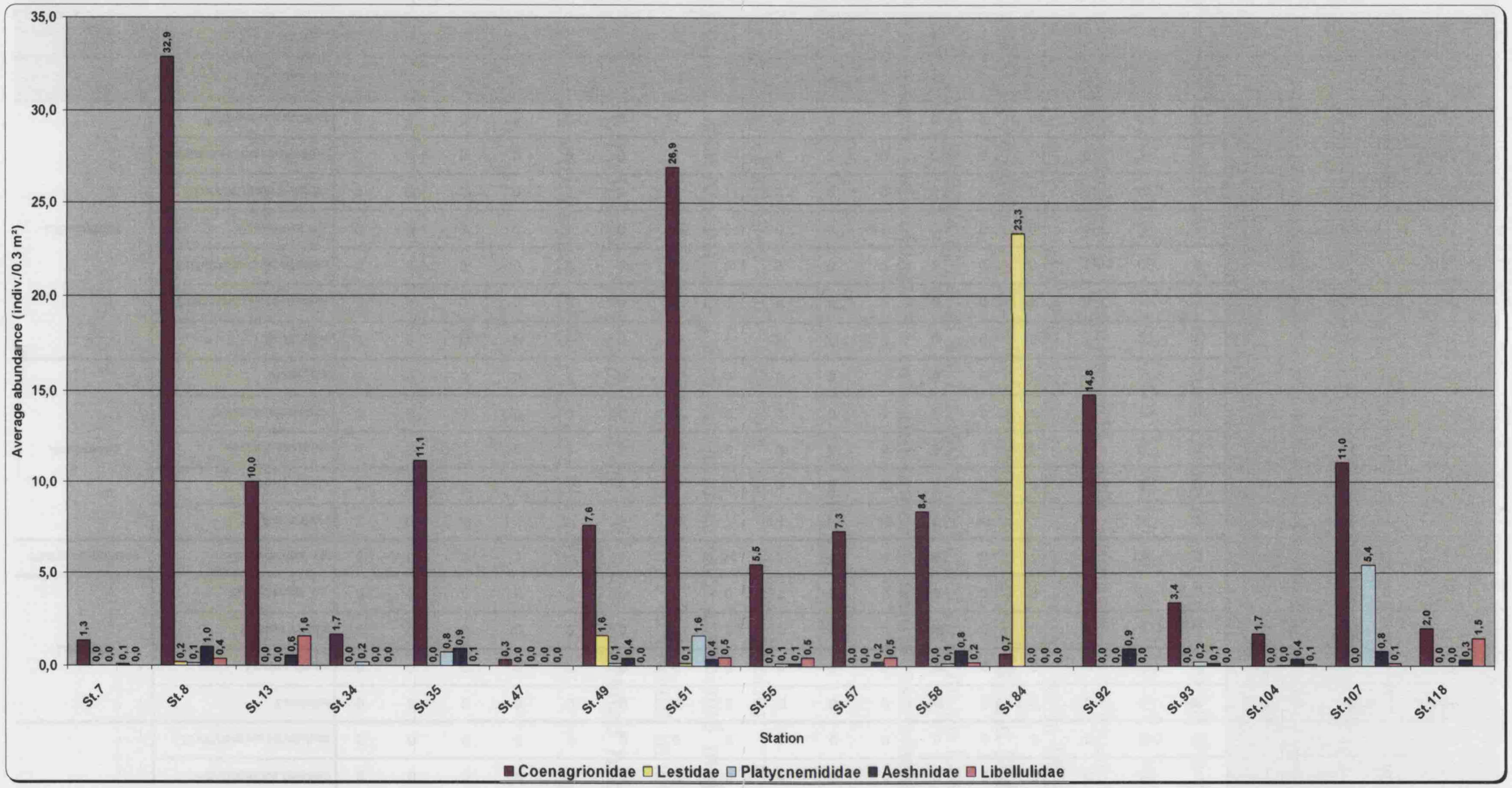


Figure (5.2.11): Average abundance (individuals/0.3 m^2) of the families of Odonata recorded in the study stations of the Southeast Regional Park during the study period.

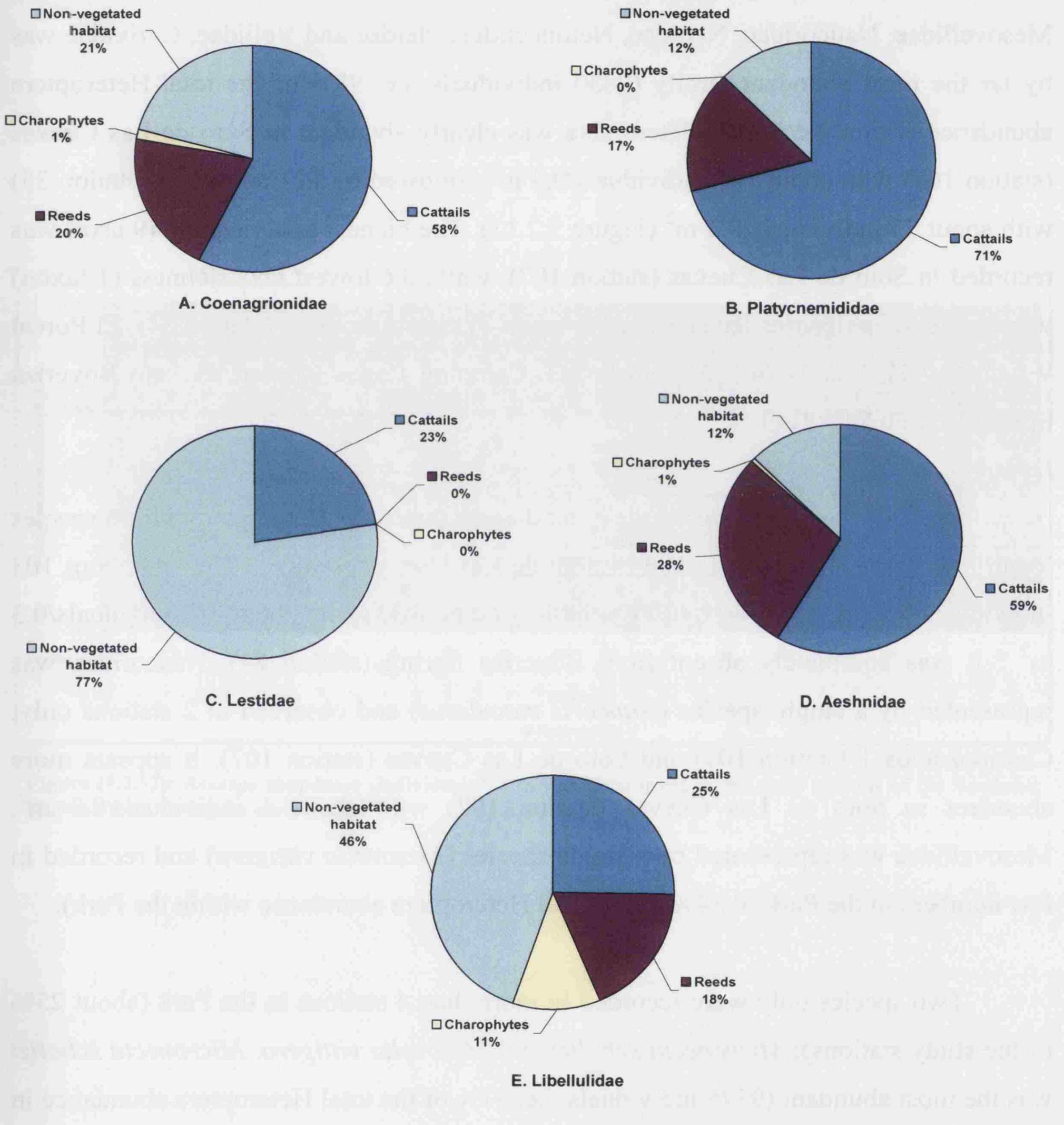


Figure (5.2.12): Total abundance of the families of Odonata recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period. A: Coenagrionidae; B: Platycnemididae; C: Lestidae; D: Aeshnidae; E: Libellulidae.

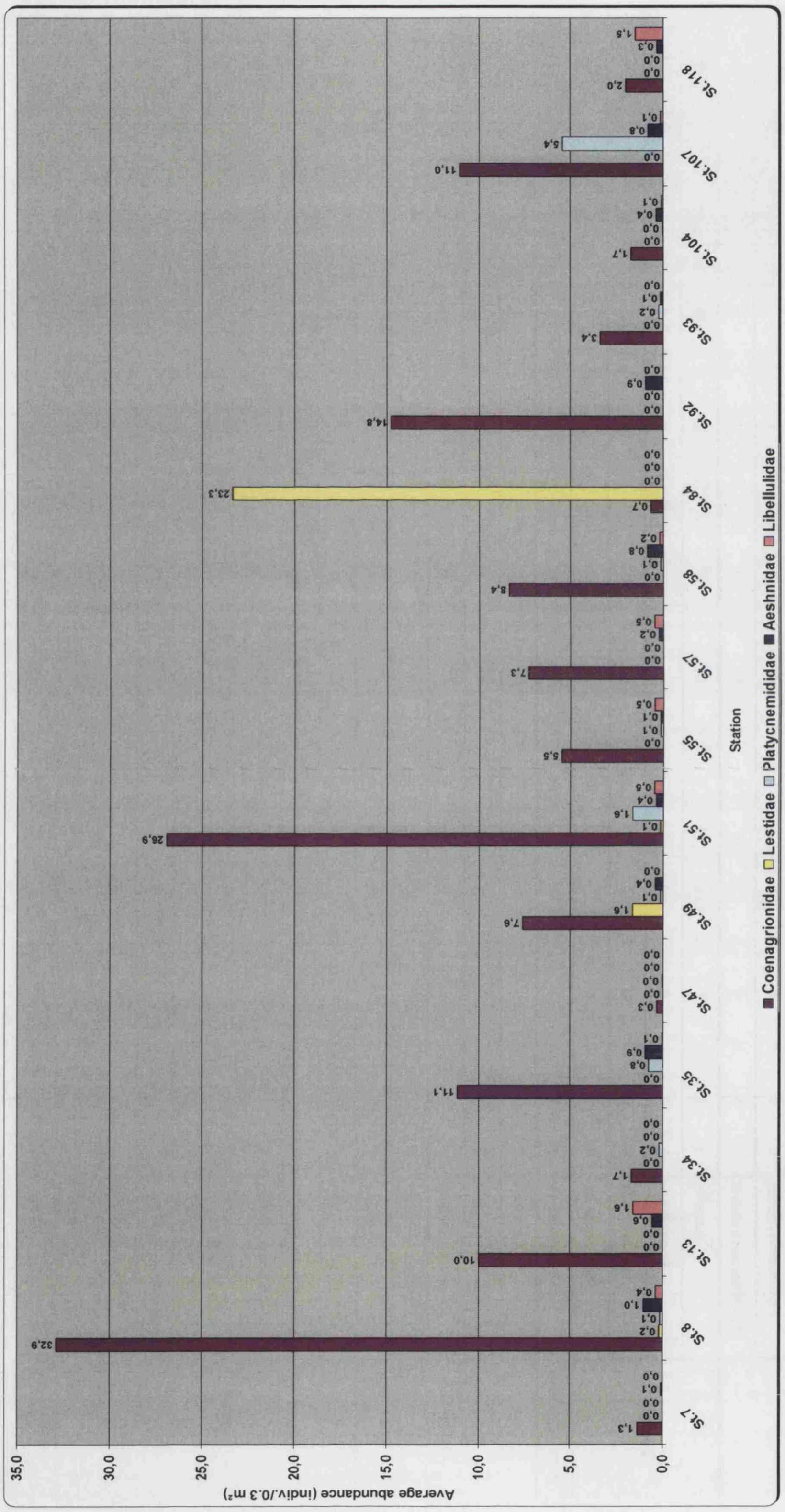


Figure (5.2.11): Average abundance (individuals/0.3 m^2) of the families of Odonata recorded in the study stations of the Southeast Regional Park during the study period.

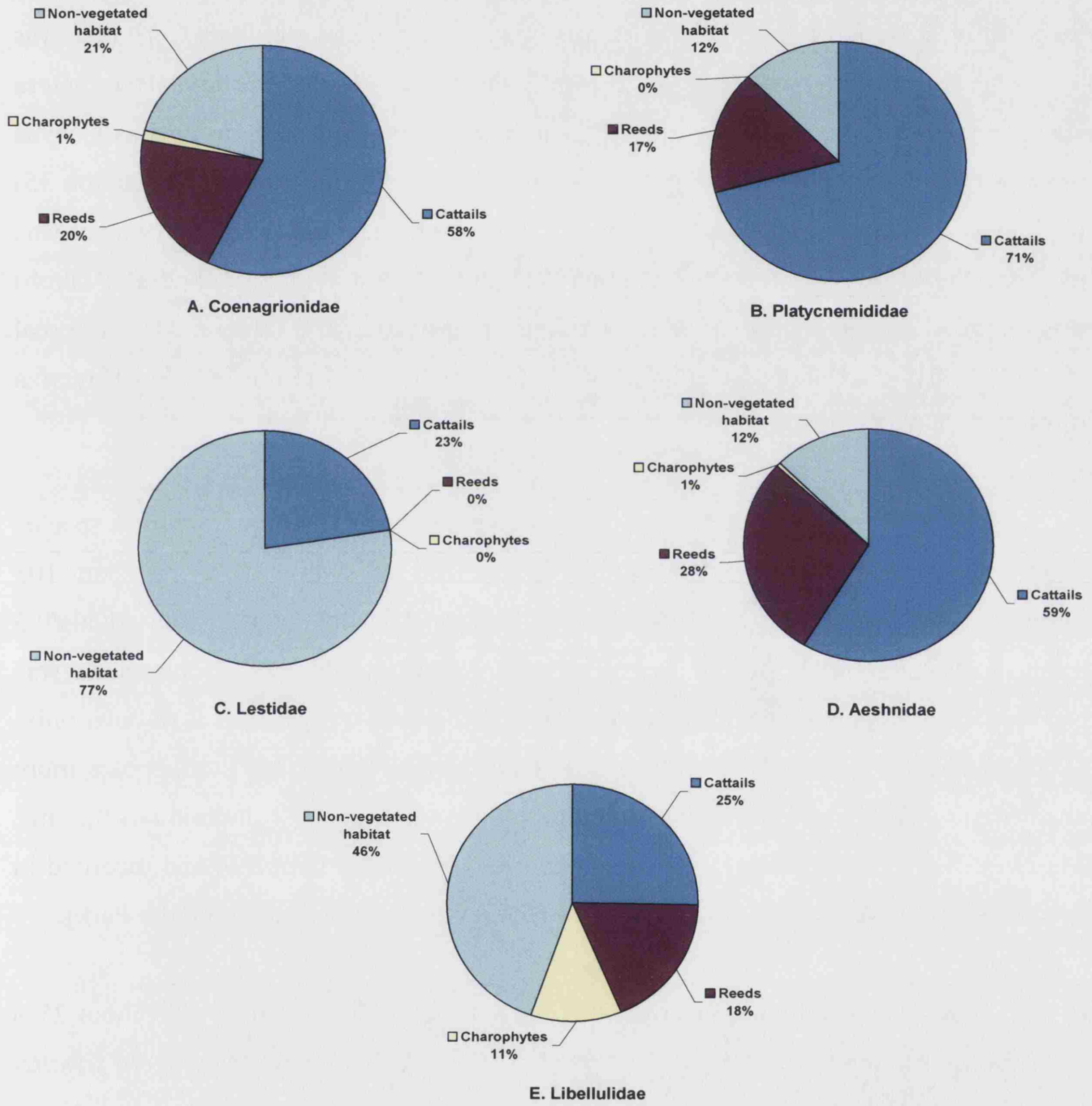


Figure (5.2.12): Total abundance of the families of Odonata recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period. A: Coenagrionidae; B: Platycnemididae; C: Lestidae; D: Aeshnidae; E: Libellulidae.

5.2.4.3. HETEROPTERA

During the study period, a total of 10033 heteropteran individuals from 17 taxa were identified. Heteroptera was represented by 8 families Corixidae, Gerridae, Mesovellidae, Naucoridae, Nepidae, Notonectidae, Pleidae and Veliidae. Corixidae was by far the most abundant family (9830 individuals, i.e. 98% of the total Heteroptera abundance within the Park). Heteroptera was clearly abundant in Soto de Las Cuevas (station 107) with about 107 individuals/0.3 m^2, followed by El Campillo 1 (station 35) with about 75 individuals/0.3 m^2 (Figure 5.2.13). The highest taxa richness (9 taxa) was recorded in Soto de Las Cuevas (station 107), while the lowest taxa richness (1 taxon) was recorded in Henares River Dam 1 (station 7), San Antonio 5 (station 34), El Porcal 9 (station 47), Las Madres 3 (station 51), Camping Lagos (station 55) and Boyeriza Spring (station 84) (Table 5.2.9).

Corixidae was considered the most diverse family of Heteroptera with 6 species identified. It was clearly abundant in Soto de Las Cuevas (station 107) with about 103 individuals/0.3 m^2, followed by El Campillo 1 (station 35) with about 75 individuals/0.3 m^2 . It was completely absent from Boyeriza Spring (station 84). Naucoridae was represented by a single species (*Naucoris maculatus*) and observed in 2 stations only; Ciempozuelos 1 (station 104) and Soto de Las Cuevas (station 107). It appears more abundant in Soto de Las Cuevas (station 107) with about 4 individuals/0.3 m^2. Mesovellidae was represented by a single species (*Mesovelia vittigera*) and recorded in few numbers in the Park (0.34% of the total Heteroptera abundance within the Park).

Two species only were recorded in more than 4 stations in the Park (about 25% of the study stations); *Micronecta scholtzi* and *Mesovelia vittigera*. *Micronecta scholtzi* was the most abundant (9775 individuals, i.e. 97% of the total Heteroptera abundance in the Park) and frequent (recorded in 14 station) heteropteran species in the Park. It was clearly abundant in Soto de Las Cuevas (stations 107) with about 102 individuals/0.3 m^2, and to some extent, appears to prefer non-vegetated habitats (76%). *Mesovelia vittigera* was observed in 7 stations in the Park and appears little abundant (when present, no more than about 1 individuals/0.3 m^2). This species appeared associated with cattails (76%). *Naucoris maculatus* appeared associated with reeds (64%) and cattails (35%) (Figure 5.2.14).

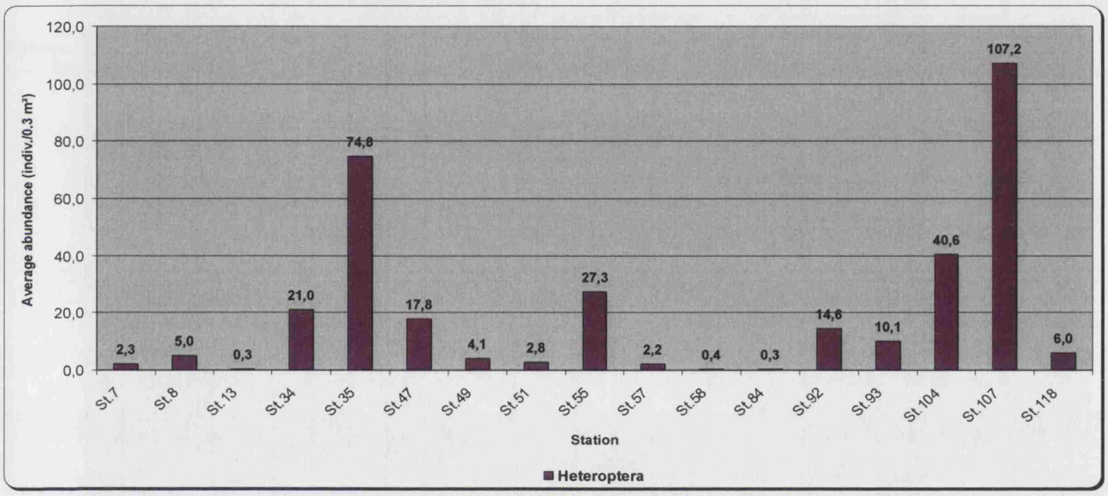


Figure (5.2.13): Average abundance (individuals/0.3 m^2) of Heteroptera in the study stations of the Southeast Regional Park during the study period.

Table (5.2.9): Heteropteran taxa collected from the study stations of the Southeast Regional Park during the study period.

Family	Taxa	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	Abundance %
Corixidae	Corixidae	0	0	2	0	1	0	0	0	0	0	0	0	0	2	0	10	33	48	5	0,48
	Corixa affinis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0,01
	Corixa panzeri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0,01
	Heliocorisa vermiculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0,01
	Hesperocorixa linnaei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0,01
	Micronecta scholtzi	55	103	0	126	2690	426	97	59	655	91	8	0	155	170	1446	3694	0	9775	14	97,43
	Sigara lateralis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	2	0,03
Gerridae	*Gerris argentatus*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0,01
	Gerris lateralis	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2	2	0,02
	Gerris sp.	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	4	3	0,04
Mesovellidae	*Mesovelia vittigera*	0	3	0	0	1	0	0	0	0	4	2	0	17	0	6	0	1	34	7	0,34
Naucoridae	*Naucoris maculatus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	145	0	149	2	1,49
Nepidae	*Nepa cinerea*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	6	2	0,06
Notonectidae	*Anisops sardeus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	2	0,02
	Notonecta sp.	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1	0,02
Pleidae	*Plea minutissima*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	2	0,02
Veliidae	*Microvelia pygmaea*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0,01
	Heteroptera abundance	55	106	3	126	2692	426	99	59	655	98	10	2	175	172	1460	3859	36	10033		
	Richness	1	2	2	1	3	1	3	1	1	4	2	1	5	2	6	9	4			
	No. of replicas	24	21	9	6	36	24	24	21	24	45	24	6	12	17	36	36	6			
	Average abundance (individuals/0.3 m²)	2,29	5,05	0,33	21,00	74,78	17,75	4,13	2,81	27,29	2,18	0,42	0,33	14,58	10,12	40,56	107,19	6,00			

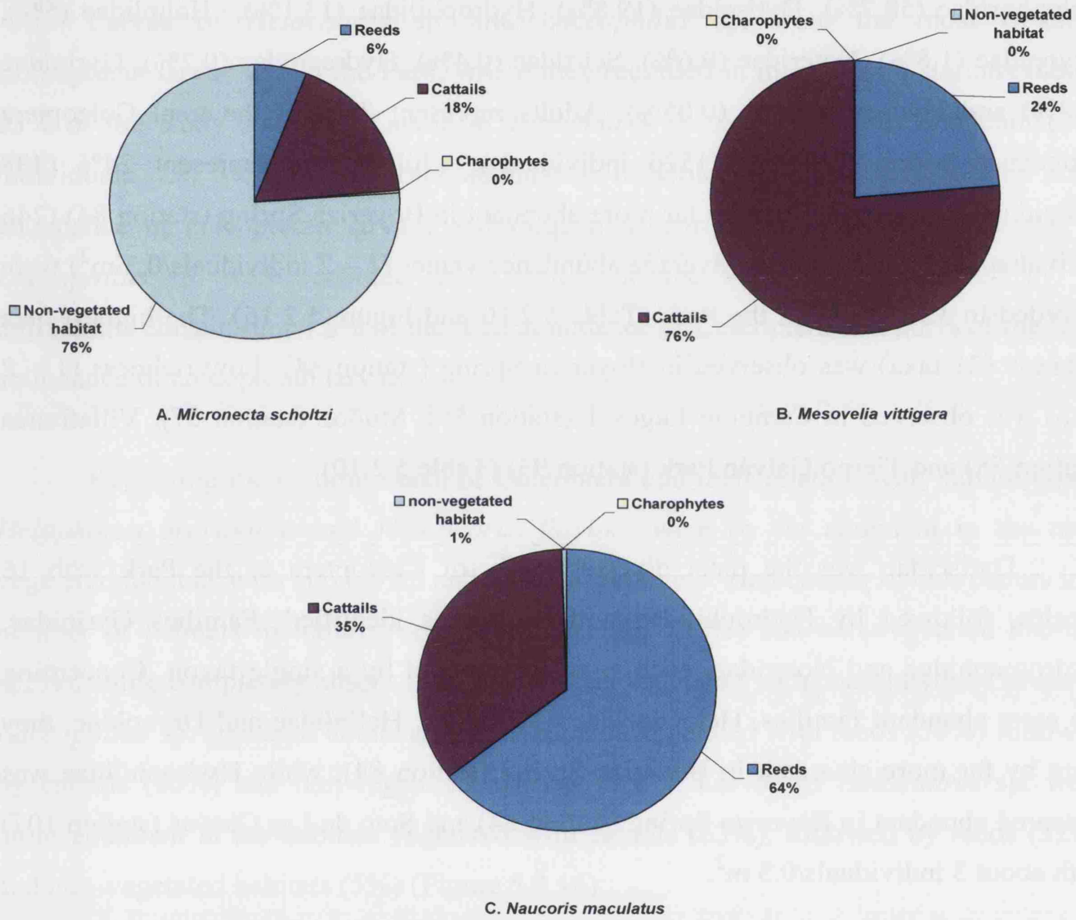


Figure (5.2.14): Total abundance of *Micronecta scholtzi* (A), *Mesovelia vittigera* (B) and *Naucoris maculatus* (C) recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

5.2.4.4. COLEOPTERA

A total of 2014 coleopteran individuals from 45 taxa were identified from all the samples during the study period. Coleoptera was represented by 10 families Helophoridae (58,7%), Dytiscidae (19,8%), Hydrophilidae (13,1%), Haliplidae (5%), Dryopidae (1,8%), Noteridae (0,6%), Scirtidae (0,4%), Hydraenidae (0,2%), Gyrinidae (0,2%) and Hydroscaphidae (0,05%). Adults represent 76% of the total Coleoptera abundance within the Park (1526 individuals), while larvae represent 24% (488 individuals). Coleoptera was by far more abundant in Boyeriza Spring (station 84) (246 individuals/0.3 m^2). Very low average abundance values (1 – 2 individuals/0.3 m^2) were recorded in 12 stations in the Park (Table 5.2.10 and Figure 5.2.15). The highest taxa richness (21 taxa) was observed in Boyeriza Spring (station 84). Low richness (1 – 2 taxa) was observed in Camping Lagos 1 (station 55), Muñoz (station 57), Villafranca (station 58) and Tierno Galván Park (station 93) (Table 5.2.10).

Dytiscidae was the most diverse family of Coleoptera in the Park with 16 species, followed by Hydrophilidae with 6 species identified. Families Gyrinidae, Hydroscaphidae and Noteridae, each were represented by a single taxon. Concerning the most abundant families, Helophoridae, Dytiscidae, Haliplidae and Dryopidae, they were by far more abundant in Boyeriza Spring (station 84), while Hydrophilidae was appeared abundant in Boyeriza Spring (station 84) and Soto de Las Cuevas (station 107) with about 3 individuals/0.3 m^2.

Three adult species only were recorded in more than 4 stations in the Park (about 25% of the study stations); *Helochares lividus*, *Helophorus brevipalpis* and *Helophorus flavipes*. *Helochares lividus* was the most frequent adult species of Coleoptera in the Park (recorded in 7 stations) and appeared little abundant in the Park (no more than 1 individuals/0.3 m^2). *Helophorus brevipalpis* was recorded in 5 stations and it was the most abundant species of Coleoptera within the Park (1089 individuals, i.e. 54% of the total coleopteran abundance and 71% of the total abundance of coleopteran adults), followed by *Hydroporus pubescens* (102 individuals, i.e. 5%), *Haliplus lineatocollis* (92 individuals, i.e. 4.6%) and *Helophorus flavipes* (82 individuals, i.e. 4% of the total Coleoptera abundance). These species were mainly abundant in Boyeriza Spring (station 84).

Larvae of *Helochares* sp. and *Laccophilus* sp. were the most frequent Coleopteran larvae within the Park, where they recorded in more than 4 stations (about 25% of the study stations). Larvae of *Helochares* sp. were the most abundant (208 individuals, i.e. 10% of the total abundance of Coleoptera and 43% of the total abundance of coleopteran larvae) and frequent (recorded at 11 stations). Larvae of *Laccophilus* sp. were recorded in 8 stations in the Park and represented by 96 individuals constituting 4.8% of the total abundance of Coleoptera and 20 % of the total abundance of coleopteran larvae.

Regarding the common taxa of Coleoptera and their relation with habitat types, *Helophorus brevipalpis* and *Helophorus flavipes* were by far abundant in the non-vegetated habitats with about 99.5 and 95%, respectively. *Helochares lividus* occurs in a number of habitats including reeds (41%), cattails (37%) and non-vegetated habitats (22%), while completely absent from the habitats vegetated with charophytes. Larvae of *Laccophilus* sp. appeared abundant in the habitats vegetated with reeds (50%) followed by cattails (35%) and non-vegetated habitats (15%). Larvae of *Helochares* sp. were more abundant in the habitats vegetated with cattails (63%), followed by reeds (32%) and non-vegetated habitats (5%) (Figure 5.2.16).

Table (5.2.10): Coleopteran taxa collected from the study stations of the Southeast Regional Park during the study period.

Family	Taxa	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	% Abundance
Dryopidae	*Dryops luridus*	0	0	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	**34**	**1**	**1,69**
	Dryops sp. (L)	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	**3**	**2**	**0,15**
Dytiscidae	*Agabus nebulosus*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
	Agabus sp. (L)	0	0	0	1	0	0	0	0	0	0	0	36	0	0	0	0	2	**39**	**3**	**1,94**
	Hydroglyphus geminus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
	Hydroglyphus signatellus	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**7**	**1**	**0,35**
	Hydroporus nigrita	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**	**1**	**0,10**
	Hydroporus obsoletus	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	**4**	**1**	**0,20**
	Hydroporus pubescens	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	2	**102**	**2**	**5,06**
	Hydroporus sp. (A)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**	**1**	**0,10**
	Hygrotus inaequalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	**1**	**0,05**
	Hygrotus sp. (L)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**	**1**	**0,10**
	Laccophilus hyalinus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	**2**	**2**	**0,10**
	Laccophilus minutus	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	**6**	**2**	**0,30**
	Laccophilus sp. (L)	0	3	4	0	15	3	0	0	0	0	0	8	0	0	1	46	16	**96**	**8**	**4,77**
	Ilybius sp. (L)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	63	19	**83**	**3**	**4,12**
	Stictotarsus griseostriatus	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	**3**	**3**	**0,15**
	Rhantus suturalis	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	**3**	**2**	**0,15**
	Oreodytes sp. (L)	0	0	0	13	0	0	0	0	0	0	0	0	0	1	0	0	0	**14**	**2**	**0,70**
	Hydrovatus cuspidatus	0	15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	**18**	**3**	**0,89**
	Hydrovatus sp. (L)	0	5	0	0	1	0	0	0	0	0	0	2	0	0	0	0	2	**10**	**4**	**0,50**
	Stictonectes lepidus	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**	**1**	**0,10**
Gyrinidae	*Gyrinus* sp. (L)	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	**4**	**3**	**0,20**
Haliplidae	*Haliplus lineatocollis*	0	0	0	0	0	0	0	0	0	0	0	92	0	0	0	0	0	**92**	**1**	**4,57**
	Haliplus sp. (L)	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**8**	**1**	**0,40**
Helophoridae	*Helophorus alternans*	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	2	**6**	**4**	**0,30**
	Helophorus brevipalpis	0	0	0	0	0	1	0	0	0	0	0	1084	1	0	2	0	1	**1089**	**5**	**54,07**
	Helophorus aquaticus	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	**4**	**1**	**0,20**
	Helophorus flavipes	1	1	0	0	0	0	0	0	0	0	1	78	1	0	0	0	0	**82**	**5**	**4,07**
	Helophorus minutus	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	**2**	**1**	**0,10**
Hydraenidae	*Hydraena* sp. (A)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
	Ochthebius sp. (A)	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	**4**	**3**	**0,20**
Hydrophilidae	*Anacaena globulus*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	**2**	**2**	**0,10**
	Berosus hispanicus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
	Berosus sp. (L)	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**6**	**2**	**0,30**
	Coelostoma sp. (L)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
	Helochares lividus	0	0	0	0	2	1	0	1	0	0	0	6	0	0	1	15	1	**27**	**7**	**1,34**
	Helochares sp. (L)	15	5	1	0	22	5	0	0	0	0	0	2	13	2	22	108	13	**208**	**11**	**10,33**
	Hydrobius fuscipes	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	**10**	**1**	**0,50**
	Laccobius sinuatus	0	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	**4**	**3**	**0,20**
	Laccobius sp. (L)	0	0	1	0	0	0	0	1	0	2	0	0	0	0	1	0	0	**5**	**4**	**0,25**
Hydroscaphidae	*Hydroscapha* sp. (A)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**	**1**	**0,05**
Noteridae	*Noterus laevis*	0	2	0	0	5	0	0	0	0	0	0	0	0	0	0	2	4	**13**	**4**	**0,65**
Scirtidae	*Cyphon* sp. (L)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**	**1**	**0,10**
	Hydrocyphon sp. (L)	4	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	**7**	**3**	**0,35**
	Coleoptera abundance	**20**	**34**	**29**	**20**	**48**	**13**	**2**	**6**	**1**	**3**	**2**	**1476**	**17**	**3**	**28**	**242**	**70**	**2014**		
	Richness	**3**	**9**	**9**	**7**	**8**	**7**	**2**	**5**	**1**	**2**	**2**	**21**	**4**	**2**	**6**	**8**	**16**			
	No. of replicas	**24**	**21**	**9**	**6**	**36**	**24**	**24**	**21**	**24**	**45**	**24**	**6**	**12**	**17**	**36**	**36**	**6**			
	Average abundance (individuals/0.3 m²)	**0,83**	**1,62**	**3,22**	**3,33**	**1,33**	**0,54**	**0,08**	**0,29**	**0,04**	**0,07**	**0,08**	**246,00**	**1,42**	**0,18**	**0,78**	**6,72**	**11,67**			

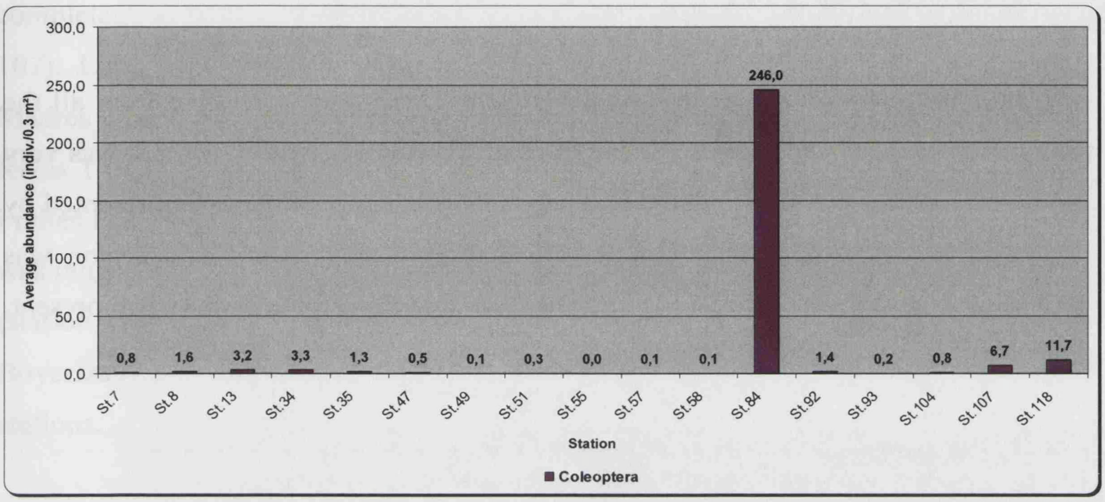


Figure (5.2.15): Average abundance (individuals/0.3 m^2) of Coleoptera in the study stations of the Southeast Regional Park during the study period.

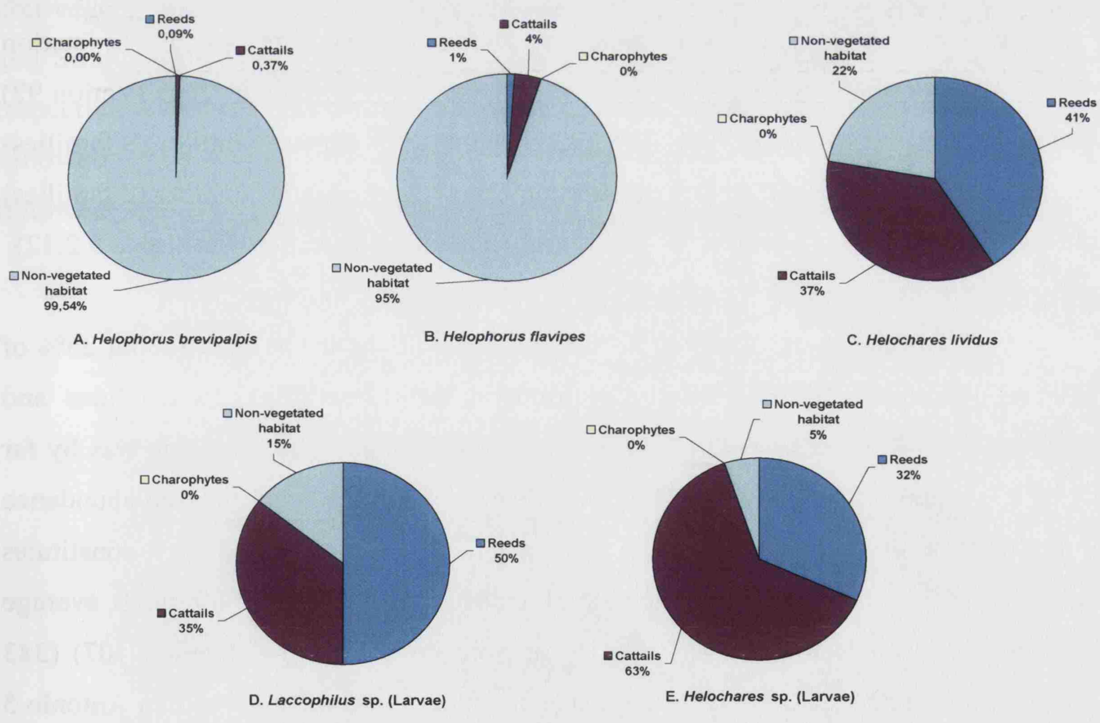


Figure (5.2.16): Total abundance of *Helophorus brevipalpis* (A), *Helophorus flavipes* (B), *Helochares lividus*, *Laccophilus* sp. (larvae) (C) and *Helochares* sp. (larvae) (D) recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period.

5.2.4.5. TRICHOPTERA

A total of 41 trichopteran individuals from 4 taxa were identified from all the samples during the study period. The presence of Trichoptera within the Park was very rare (0.05 % of the total macroinvertebrate abundance). Trichoptera was represented by 2 species; *Ecnomus deceptor* and *Orthotrichia angustella. Ecnomus deceptor* was relatively frequent (recorded in 5 stations) but not abundant in the Park (when present, no more than 1 individual/0.3 m^2) (Table 5.2.11).

5.2.4.6. DIPTERA

During the study period, a total of 47391 dipteran individuals from 13 families (Ceratopogonidae, Chaoboridae, Chironomidae, Culicidae, Dixidae, Dolichopodidae, Empididae, Limoniidae, Psychodidae, Stratiomyidae, Syrphidae, Tabanidae and Tipulidae) were recorded. Diptera was clearly abundant in Soto de Las Cuevas (station 107) with about 386 individuals/0.3 m^2, followed by San Martín de la Vega (station 92) with about 291 individuals/0.3 m^2. The highest number of Diptera families (9 families) was recorded in San Martín de la Vega (station92), while the lowest number (2 families) was recorded in Rivas 1 (station 13) and Tierno Galván Park (station 93) (Table 5.2.12).

Five families were observed in more than 4 stations in the Park (about 25% of the study stations); Chironomidae, Ceratopogonidae, Limoniidae, Psychodidae and Stratiomyidae. When compared to other families of Diptera, Chironomidae was by far the most abundant family (44849 individuals, i.e. 95 % of the total dipteran abundance in the Park). It also considers the most abundant family in the Park where it constitutes about 60% of the total macroinvertebrate abundance in the Park. The highest average abundance of Chironomidae was recorded in Soto de Las Cuevas (station 107) (383 individuals/0.3 m^2), while the lowest average abundance was recorded in San Antonio 5 (station 34) and Boyeriza Spring (station 84) with about 11 and 14 individuals/0.3 m^2, respectively (Figure 5.2.17). Ceratopogonidae was recorded in 15 stations and appeared more abundant in Muñoz (station 57) with about 34 individuals/0.3 m^2. It was completely absent from San Antonio 5 (station 34) and Soto de Las Cuevas (station 107). Limoniidae was recorded in 12 stations and appeared more abundant in Las Madres 3 (station 51) with about 5 individuals/0.3 m^2. It was completely absent from Rivas 1 (station 13), San Antonio 5 (station 34), Boyeriza Spring (station 84) and Los Frailes (station 118). Psychodidae was recorded in 8 stations. Their average abundance was ranged from 0 (in 9 stations in the Park) to about 6 individuals/0.3 m^2 in Los Frailes (station 118). Stratiomyidae was recorded in 7 stations and appeared more abundant in Boyeriza Spring (station 84) (10 individuals/0.3 m^2) when compared to the other stations.

Regarding the relation between the most common and abundant families of Diptera and their habitat types, Chironomidae was appeared to prefer a number of habitats, where it found abundant in habitats vegetated with cattails (44%), followed by non-vegetated habitats (35%), reeds (20%) and charophytes with 1%. Ceratopogonidae and Stratiomyidae were abundant mainly in the non-vegetated habitats (86 and 85%, respectively). Limoniidae was clearly abundant in the habitats with cattails (73%), followed by reeds (23%). Psychodidae was abundant in the habitats with cattails (64%), followed by non-vegetated habitats (36%) (Figure 5.2.18).

Table (5.2.11): Trichoptera taxa collected from the study stations of the Southeast Regional Park during the study period.

Family	Taxa	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	Abundance %
Hydroptilidae	*Orthotrichia angustella*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	2,44
Limnephilidae	Limnephilidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2,44
Polycentropodidae	Polycentropodidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	2,44
Ecnomodae	*Ecnomus deceptor*	0	0	0	0	1	0	9	11	0	16	1	0	0	0	0	0	0	38	5	92,68
	Total no. of individuals	0	0	0	0	1	0	9	12	1	17	1	0	0	0	0	0	0	41		
	Richness	0	0	0	0	1	0	1	2	1	2	1	0	0	0	0	0	0			
	No. of replicas	24	21	9	6	36	24	24	21	24	45	24	6	12	17	36	36	6			
	Average abundance (individuals/0.3 m^2)	0,00	0,00	0,00	0,00	0,03	0,00	0,38	0,57	0,04	0,38	0,04	0,00	0,00	0,00	0,00	0,00	0,00			

Table (5.2.12): Diptera families collected from the study stations of the Southeast Regional Park during the study period.

Family	St.7	St.8	St.13	St.34	St.35	St.47	St.49	St.51	St.55	St.57	St.58	St.84	St.92	St.93	St.104	St.107	St.118	Total	Occurrence	Abundance %
Ceratopogonidae	25	9	127	0	3	1	1	15	3	1525	57	2	11	1	1	0	8	1789	15	3,77
Chaoboridae	0	1	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	7	3	0,01
Chironomidae	3119	4573	518	64	4015	801	1025	2116	825	2314	1485	84	3419	1932	3971	13790	798	44849	17	94,64
Culicidae	0	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	1	8	3	0,02
Dixidae	1	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	7	3	0,01
Dolichopodidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0,00
Empididae	1	0	0	2	0	0	0	0	0	0	2	0	3	0	0	0	0	8	4	0,02
Limoniidae	34	27	0	0	47	8	74	105	13	39	66	0	37	0	10	101	0	561	12	1,18
Psychodidae	0	0	0	0	1	0	2	2	0	0	0	2	6	0	22	4	34	73	8	0,15
Stratiomyidae	1	3	0	0	1	0	0	2	0	0	0	58	3	0	0	1	0	69	7	0,15
Syrphidae	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	5	2	0,01
Tabanidae	0	0	0	1	0	0	0	0	0	0	1	4	0	0	1	0	0	7	4	0,01
Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	7	3	0,01
Total no. of individuals	3181	4614	645	68	4071	810	1102	2240	844	3878	1611	160	3490	1933	4005	13897	842	47391		
Richness	6	6	2	4	7	3	4	5	4	3	5	7	9	2	5	5	5			
No. of replicas	24	21	9	6	36	24	24	21	24	45	24	6	12	17	36	36	6			
Average abundance (individuals/0.3 m^2)	132,54	219,71	71,67	11,33	113,08	33,75	45,92	106,67	35,17	86,18	67,13	26,67	290,83	113,71	111,25	386,03	140,33			

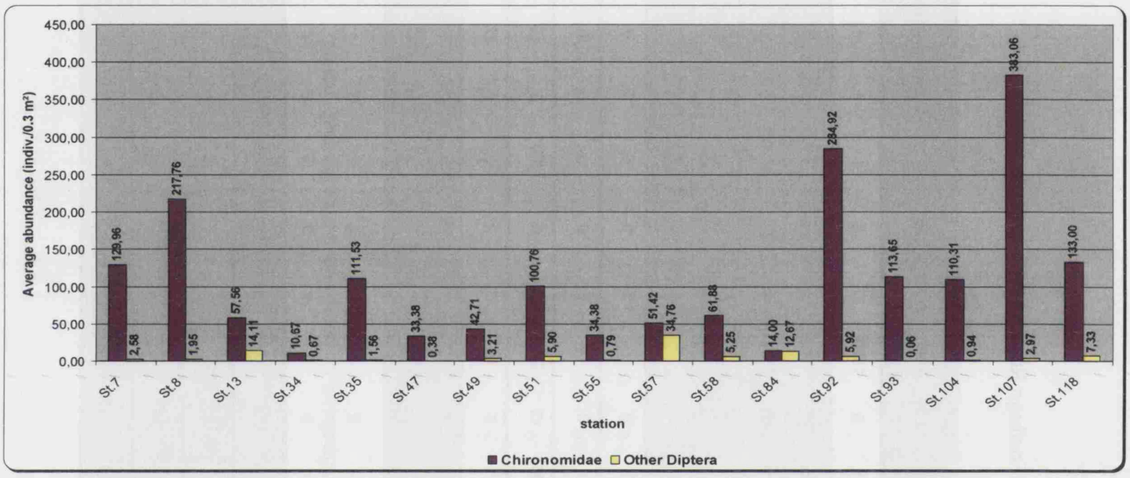


Figure (5.2.17): Average abundance (individuals/0.3 m^2) of Chironomidae compared with other Diptera in the study stations of the Southeast Regional Park during the study period.

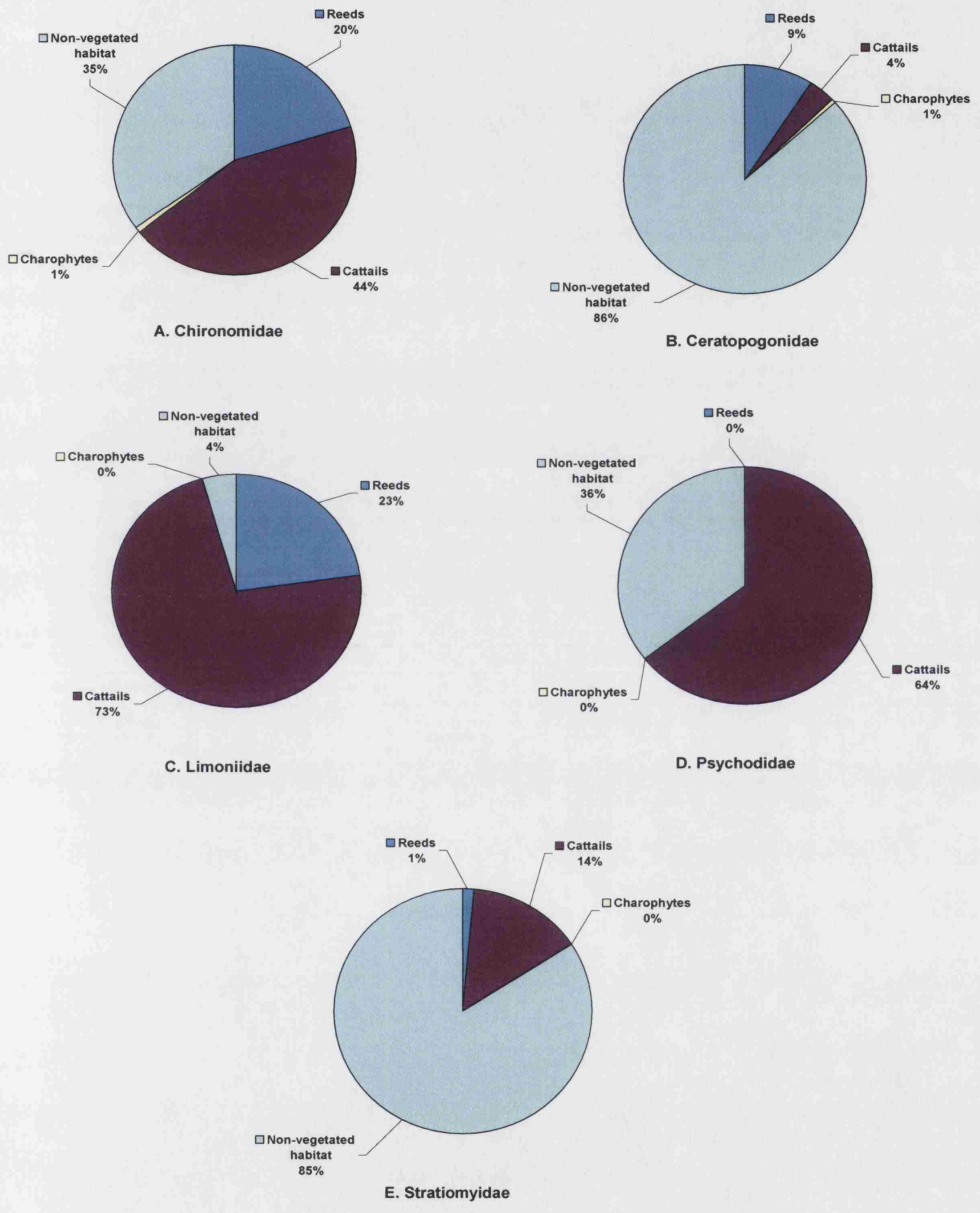


Figure (5.2.18): Total abundance of the most common and abundant families of Diptera recorded in the Southeast Regional Park, in relation to habitat types (habitats vegetated with reeds, cattails and charophytes and non-vegetated habitats) during the study period. A: Chironomidae; B: Ceratopogonidae; C: Limoniidae; D: Psychodidae; E. Stratiomyidae.

6

DISCUSSION

6. Discussion

Aquatic invertebrates can be found in nearly any habitat from small temporary pools to large lakes and small springs to large rivers. In lentic, or standing waters, aquatic invertebrates occur at the bottoms of deep lakes, along vegetated margins, and in open water (Bouchard, 2004). In the present investigation, the macroinvertebrate collection process was only restricted to the littoral zone. This zone is of critical ecological importance since it is considered the main site of secondary production in lakes (Vadeboncoeur *et al.*, 2002; Cremona *et al.*, 2008). It is typically supports the largest and most diverse populations of invertebrates due to the diverse habitat (like aquatic vegetation, soft sediments and woody debris). Generally, vegetated wetlands harbor more macroinvertebrates than non-vegetated wetlands (Rasmussen and Rowan, 1997; Kostecke *et al.*, 2005). A decline in macrophyte cover is often followed by a decline in zoobenthic biomass (Davies, 1982). In shallow waters, macrophytes provide shelter for fauna from disturbance and predation, as well as a large surface for colonization of algae that represent a food source for the majority of invertebrates (Watkins *et al.*, 1983; Rasmussen and Rowan, 1997; Pinowska, 2002; Tessier *et al.*, 2004; Cañedo-Argüelles and Rieradevall, 2009). However, our results are in agreement with the later studies, where the habitats vegetated with cattails supported the highest macroinvertebrate abundance (223 individuals/0.3 m^2), followed by charophytes (209 individuals/0.3 m^2), non-vegetated habitats (206 individuals/0.3 m^2) and reeds (160 individuals/0.3 m^2). Also, the highest taxa richness was recorded in the habitats vegetated with cattails (70% of total taxa richness) followed by non-vegetated habitats, reeds and charophytes with about 67, 43 and 14% of total taxa richness. Generally, the higher macroinvertebrate abundance in the studied habitats within the Park was mainly due to the higher abundance of chironomids (60% of the total abundance of macroinvertebrates in the Park). During our study, oligochaetes, *Caenis luctuosa*, *Micronecta scholtzi*, *Dryops luridus*, *Hydroporus pubescens*, *Haliplus lineatocollis*, *Helophorus brevipalpis*, *Helophorus minutus*, and ceratopogonids, were clearly abundant in the non-vegetated habitats. Baetids, Coenagrionids, *Platycnemis* sp., *Ilybius* sp. (larvae), chironomids and limoniids, were clearly abundant in the habitats vegetated with cattails. *Naucoris maculatus*, *Laccophilus* sp. (larvae), *Helochares* sp. (larvae), were noticeably abundant in both habitats vegetated with reeds and cattails.

Aquatic macroinvertebrates was estimated to be about 126.000 freshwater animal species. The record of 126.000 species represents 9.5% of the total number of animal species recognised. The majority of the 126,000 freshwater animal species are insects (60.4%) (Balian *et al.,* 2008). Several orders of aquatic insects are sensitive to many types of pollution and mostly represented by orders Ephemeroptera, Plecoptera and Trichoptera (Ortiz and Puig, 2007; Sahuquillo *et al.,* 2007; Trigal *et al.,* 2009; Parsons *et al.,* 2010). These aquatic insects need healthy water quality to survive, and they can be useful as indicators of good water quality. Several other orders of aquatic insects are indifferent to or tolerant of water pollution, such as Diptera (midges) (Telesh *et al.,* 1999; McCormick *et al.,* 2004; Ortiz and Puig, 2007; Sahuquillo *et al.,* 2007; Song *et al.,* 2007; Kucuk, 2008; Marziali *et al.,* 2008). In many cases, these indicate poor water quality, especially if they are the only macroinvertebrates found.

In the present investigation, insects dominated the assemblage during the study period, either in the number of different taxa identified (104 taxa, i.e. 94.5 %) or quantitatively (69015 individuals, i.e. 92%). The insect fauna consists primarily of Diptera (true flies), Heteroptera (true Bugs), Ephemeroptera (mayflies), Odonata (dragonflies and damselflies), Coleoptera (beetles) and Trichoptera (caddisflies). All of these orders (except Ephemeroptera and Trichoptera) can tolerate varying degrees of water pollution, and there presence is an indication of poor water quality. Regarding the sensitive order Ephemeroptera recorded in the Park, it was represented by two families Baetidae, which is tolerant to a moderate level of pollution (Hilsenhoff, 1988) and Caenidae, which is generally more pollution-tolerant than other mayfly families (Hilsenhoff, 2001; Gooderham and Tsyrlin, 2002; Dominguez *et al.,* 2006). Also, 93% of the trichopteran individuals within the Park belong to *Ecnomus deceptor* (Ecnomidae), which can tolerate high salinities and can be present in quite eutrophic waters (Bonada, 2003). Hence, we can say that all the aquatic insect groups recorded in the Southeast Regional Park tend to be tolerant of most forms of pollution, and this result agree with the results of Alvarez Cobelas *et al.*, (2000). He stated that the wetlands of the Southeast Regional Park have a greatest value lies in their abundance and the diversity of their trophic level within a gypsum landscape very rare in Europe. These wetlands were polluted and this is mainly due to nitrogen and phosphorus, which ingenerate eutrophication processes in them. External sources of nutrients are diffusion through undefined points. The internal load of pollutants by decaying littoral and planktonic vegetation, and that release from the sediments is important in some cases: Henares River Dam 1 (station 7), San Martín de la Vega 7 (station 92), El Porcal 9 (station 47) and El Campillo 1 (station 35) (Alvarez Cobelas *et al.*, 2000). The origin of these pollutants is different; consequently the wetlands are subject to multiple stresses. In some cases, the pollution is due to past and present agricultural activities such as in San Martín de la Vega 7 (station 92), some wetlands are located in old agricultural fields such as Las Madres 1 and 3 (stations 49 and 51, respectively), Camping Lagos 1 (station 55) and El Porcal 9 (station 47), others are surrounded by fields cultivated today such as Ciempozuelos 1 (station 104). In other locations, the contribution of nitrogen and phosphorus can come from the direct infiltration from the nearby river beds, heavily polluted such as El Porcal 9 (station 47), El Campillo 1 (station 35), Ciempozuelos 1 (station 104) and Soto de Las Cuevas (station 107) (Alvarez Cobelas *et al.*, 2000).

Diversity indices are among the most widely used tools in water quality assessment. Most natural communities are characterized by a large number of species with no individual species present in overwhelming numbers, while polluted habitats usually support only a few species constituting a high proportion of total biomass (Freed and Slimak, 1978). One of the simplest measures of species diversity is species richness, simply the number of species present. Although readily measured, species richness does not, however, take into account the distribution of individuals among species, and is highly influenced by sample size (Freed and Slimak, 1978). Formulae based on information theory have proven to be more satisfactory, as they take into account not only species richness, but also the distribution of individuals among species. The Shannon-Wiener diversity index is widely accepted (Lloyd *et al.*, 1968;

Freed and Slimak, 1978). A related index is evenness, which is considered as the measure of equality of abundances in a community (Alatalo, 1981). In the present investigation, the stations with higher taxa richness (36 taxa) were stations 84 (Boyeriza Spring) and 107 (Soto de Las Cuevas). Richness in Boyeriza Spring was mainly due to the higher richness of Coleoptera (21 taxa), while in Soto de Las Cuevas was mainly due to the richness of orders Odonata, Heteroptera and Coleoptera (9, 9 and 8 taxa, respectively). However, when considering these two stations according to their diversity, it appears that Boyeriza Spring has the greatest diversity of all the studied wetlands (2.69), while Soto de Las Cuevas only reaches a value of 1.66. This is because in Soto de Las Cuevas there is a very dominant taxon, Chironomidae (67.07% of total macroinvertebrates collected) that makes the evenness one of the lowest within the Park (0.32). On the other hand, in Boyeriza Spring (station 84), evenness is one of the highest within the Park (0.52) this is because the percentage abundance of Chironomidae is the least of all the studied wetlands (3.84%). In addition to the last mentioned stations, station 118 (Los Frailes) provides the second highest richness within the Park with 34 taxa (mainly, Odonata with 5 taxa, Heteroptera with 4 taxa and Coleoptera with 16 taxa), and has a diversity of 1.87, as there is a clear dominance of the Chironomidae (60.50%). On the other hand, wetlands such as Muñoz (station 57), Las Madres 1 (station 49), Las Madres 3 (station 51) and Camping Lagos 1 (station 55) have a moderate richness (19 to 28 taxa) and a diversity value between 2.66 and 2.41, due to more equitable distribution of taxa and less dominance of Chironomidae (34-56%).

It should be noted that the wetlands with the highest percentage abundance of the midge, family Chironomidae are those that concentrations of chlorophyll "a" can be defined as hypertrophic (Alvarez Cobelas *et al.,* 2000). Family Chironomidae is usually the most abundant macroinvertebrate group in numbers of species and individuals, encountered in the majority of freshwater aquatic habitats (Armitage *et al.,* 1995; Epler, 1995; van der Valk, 2006). However, to benthologists, the Chironomidae have long been known as potential indicators of water quality (Epler, 1995; McCormick *et al.,* 2004; Henriques de Oliveira *et al.,* 2007). They have been referred to as an effective tool for assessing the ecological status of lentic waters although the response of different genera and subfamilies vary (Trigal *et al.*, 2009). Chironomids are an essential element in the organic matter circulation of the lake. They dominate a sub-system that retards water quality degradation, and thus they play a prominent role in the natural prevention of eutrophication (Dévai, 1990). However, this group is rarely identified to species or genus level in ecological studies, due to the difficulty of identifying larvae (Lenat, 1983; Epler, 1995; Casas *et al.*, 2006; Song *et al.*, 2007).

As stated by Shiels (2010) the percentage abundance of Chironomidae will increase with the decrease of water quality and this percentage in the sample represents whether a water body is oligotrophic or eutrophic. A sample in which greater than 50% is Chironomidae suggests eutrophic conditions (Yandora, 1998). In addition, the values of Shannon index greater than 3 indicated clean water, values in the range of 1-3 were characterized by moderate pollution and values less than 1 characterized heavily polluted condition (Wilhm and Dorris, 1968; Chakrabarty and Das, 2006). However, during this investigation the percentage abundance of Chironomidae was often more than 50% except in 4 stations; 84 (Boyeriza Spring, 3.8%), 34 (San Antonio 5, 21.8%), 57 (Muñoz, 34%) and 55 (Camping Lagos 1, 34.6%). Henares River Dam 1 (station 7) has the highest percentages abundance of Chironomidae in the Park (82.6%), followed by San Martín de la Vega 7 (station 92) and Tierno Galván Park (station 93) with a percentage of 80.9 and 75.2%, respectively. Also, low Shannon diversity values of 0.96, 1.23 and 1.29 were recorded in stations 7 (Henares River Dam 1), 92 (San Martín de la Vega 7) and 93 (Tierno Galván Park), respectively. Thus, we can say that these wetlands have very poor habitat conditions to support benthic macroinvertebrates, judging by their percentages abundance of Chironomidae and their values of Shannon index (Wilhm and Dorris, 1968; Yandora, 1998; Chakrabarty and Das, 2006; Shiels, 2010). However, our results agree with those of Alvarez Cobelas *et al.*, (2000), who considered Henares River Dam 1 (station 7) one of the most eutrophic wetlands in the Park with very high concentrations of nitrogen and phosphorus. This wetland was not thermally stratified and the potency of the sediments was high, a meter or more, and it was in accelerated phase of silting. It also characterized by much suspended matter and much phytoplankton which sometimes gives it a greenish color that interacts with the dark brown color of the decaying cattails (Alvarez Cobelas *et al.*, 2000). San Martín de la Vega 7 (station 92) was a hypertrophic wetland. It was thermally stratified and anoxia presents during summer, but oxygen supersaturation in the surface layers due to the high production of phytoplankton, induced by the high concentrations of nutrients. The potency of the sediments was high. The water was dark (due to the decomposition of cattails) and very turbid (Alvarez Cobelas *et al.*, 2000). Tierno Galván Park (station 93) was a hypertrophic wetland. It was stratified and shows deep anoxic conditions during the summer, with the subsequent appearance of orthophosphate and ammonium in the deep zone. Water transparency was low and there were much nitrate and total phosphorus, and high phytoplankton biomass (Alvarez Cobelas *et al.*, 2000). In addition, during some months of the study period there was a decrease in the water level, leaving the littoral vegetation.

As mentioned, Henares River Dam 1 (station 7), San Martín de la Vega 7 (station 92) and Tierno Galván Park (station 93), were suffered from high accumulation of nutrients and greater potency of sediment deposition, and considered hypertrophic (Alvarez Cobelas *et al.*, 2000). Nutrient enrichment has been a major cause of reduced biodiversity and changes in community structure and composition of wetlands worldwide (Keddy, 2000). Nitrogen and phosphorus are primary metabolic nutrients, and their abundance often regulates biological productivity in wetlands. Excessive loading of nitrogen and phosphorus can cause eutrophication, leading to algae blooms and dissolved oxygen deficits (Olson, 1999). Sedimentation can have negative effects on aquatic life (Hodgman, 2006). Sedimentation impacts include increased turbidity that reduces the depth of the photic zone and increases sediment fallout which may cover primary producers and invertebrates (Gleason and Euliss, 1998). Habitat for aquatic macroinvertebrates that live on submerged rocks and logs can be smothered by sediment as well (Hodgman, 2006). Excessive sediment input thus potentially alters aquatic food webs as well as basic wetland functions related to water quality improvement, nutrient cycling, and other biogenic processes that transform and sequester pollutants (Gleason and Euliss, 1998).

Heip (1995) and Clemente *et al.* (2005) stated that eutrophication affects the richness and diversity of the macroinvertebrate community. The increased content of organic matter in the sediment and the associated oxygen decrease are the main factors determining the elimination or replacement of species. Eutrophication can have both positive and negative effects on zoobenthic communities. Increasing nutrient concentrations can stimulate pelagic primary production to the benefit of the deposit-feeding macrobenthos (Grall and Chauvaud, 2002). However, an increased sedimentation of organic matter is harmful to some benthic species via siltation, habitat modification and oxygen depletion caused by high decomposition rates (Grall and Chauvaud, 2002). The changes in the structure of the zoobenthic community due to organic enrichment were modelled by Pearson and Rosenberg (1978). The model indicates that the early stages of eutrophication and organic matter enrichment are often followed by increases in the abundance and number of species. If enrichment continues, the macrofauna disappears and the sediment eventually becomes azoic. Although the model was developed and used for analyses of marine systems that have experienced long-term eutrophication (Heip, 1995; Grall and Chauvaud, 2002; Clemente *et al.*, 2005), it describes very well the temporal pattern recorded in the Park.

The similarity in taxa composition among the studied wetlands was analyzed using the Jaccard index for calculating the extent of similarity between pairs of data sets. The index indicated that Las Madres 1 (station 49) and Las Madres 3 (station 51) were the most similar to each other in terms of macroinvertebrate diversity, with a similarity value of 0.594 between these wetlands. These two wetlands with Muñoz (station 57) and Villafranca (station 58) were found together, have the greater similarity among all the studied wetlands. Examination of the raw data (see Appendix 3) shows that these wetlands are relatively high in diversity, and have a number of taxa in common. Additionally, these wetlands have common characteristics such as physicochemical conditions, habitat types and they are oligotrophic or mesotrophic (Alvarez Cobelas *et al.*, 2000), which may have contributed to the similarity in terms of the macroinvertebrate communities they support. On the other hand, Boyeriza Spring (station 84) and Muñoz (station 57) showed the least similarity (0.094), where the taxa composition in Boyeriza Spring was mainly dominated by a single group; Coleoptera (21 from 36 taxa), while in Muñoz was represented by more than one group (mainly Ephemeroptera, Odonata and Heteroptera, each with 4 taxa). We should be noted that Boyeriza Spring is a very small natural spring and it is the unique natural habitat within the studied habitats in the Park and their conditions are drastically different from those of artificial ecosystems.

Regarding aquatic insects collected from the Southeast Regional Park, Ephemeroptera was observed in 94% of the studied wetlands in the Park. Generally, Ephemeroptera is a diverse and vital biotic component of freshwater ecosystems and their larvae are commonly used as bioindicators in many monitoring programmes (Domínguez *et al.*, 2006; Menetrey *et al.*, 2008). However, during the present investigation, in terms of species richness, this group was relatively poorly represented (4 from 110 taxa recorded within the Park). This is mainly due to the fact that most mayflies are adapted to living in lotic freshwater ecosystems (Ubero-Pascal *et al.*, 1998) where the environmental conditions are drastically different from those of lentic ecosystems. A single species dominates our data group; *Caenis luctuosa* which is known to be very tolerant to eutrophication conditions (Solimini *et al.*, 2003) and mineralized and organically polluted waters (Perán *et al.*, 1999; Buffagni *et al.*, 2009). *Caenis luctuosa* was recorded in 10 wetlands and was clearly abundant in Muñoz (station 57) with about 40% of the total abundance of this species in the Park (21 individuals/0.3 m^2). This species appears to occur in a number of habitats, but appears more abundant in non-vegetated habitats (65%)

Dragonflies and damselflies occur in a wide variety of habitats and some can withstand a range of environmental stresses. They are quite useful as indicators of environmental impact when studied at family (or lower) levels of taxonomy. A healthy stream or wetland usually supports a diverse range of odonates, while an impacted site may only boast a couple of the more pollution-tolerant species (Gooderham and Tsyrlin, 2002). There are two potential problems with the use of Odonata as indicators of water quality. Firstly, while this taxon appears to favour water bodies that contain relatively low levels of pollutants, a small number of species have been shown to tolerate relatively high levels of some substances. However, sensitivity to organic pollution is almost ubiquitous in the order and this makes them ideal as indicators of this kind of pollution. A second complicating factor with Odonata is their reported propensity for using different types of habitat in different parts of their range (Hassall *et al.*, 2010). In the present investigation, Odonata is particularly well represented, being observed in all the studied stations of the Park. In terms of species richness, they are relatively well represented (21 species from 110 taxa recorded within the Park, i.e. 19%). This number represents about 40% of the total number of odonates species recorded in the Community of Madrid (García-Avilés, 2002a).

Larvae of *Ischnura* sp. (Coenagrionidae) and *Platycnemis* sp. (Platycnemididae) were the most abundant and common species of Odonata in the Park (17 and 7% of the total abundance of Odonata, respectively) and found in 17 and 11 wetlands in the Park, respectively. According to García-Avilés (2002a), 3 species of *Ischnura* were recorded in the Park during the study period; *Ischnura elegans* (adults), *I. graellsii* (adults), and *I. pumilio* (adults). *I. elegans* and *I. graellsii* were the most common odonates in the Park (recorded in 14 stations), while *I. pumilio* were less common and was recorded in 6 stations only. These species of *Ischnura* appear to tolerate slightly brackish or moderately polluted waters (Parr, 1965; Cañedo-Argüelles and Rieradevall, 2009; De Knijf, and Demolder, 2010). *Ischnura elegans* can tolerate more pollution than any other dragonfly (Merrit *et al.*, 1996). Other species recorded during the study period by García-Avilés (2002a), such as adults of *Platycnemis latipes*, *Orthetrum cancellatum* and *Anax parthenope*, were found also common (in terms of the number of stations which it was found) in the Park and were recorded in 13, 11 and 11 stations, respectively. *Orthetrum cancellatum* is often one of the first species to colonize newly created gravel pits, sand pits and chalk quarries after they have become flooded, and can breeds in ponds, lakes, slow-moving rivers and in ditches which can be quite brackish (Merrit *et al.*, 1996; Heidemann and Seidenbusch, 2002). *Anax parthenope* also can tolerate some degree of water pollution (Lockwood and Oliver, 2007). Regarding the habitats where larvae of Odonata live, *Ischnura* sp. and *Platycnemis* sp. were found associated with cattails.

Aquatic heteropterans are widespread insects capable of colonizing nearly all types of aquatic habitats, and are often one of the first successional stages in newly created water bodies, such as artificial ponds (Papacek, 2001; Foltz and Dodson, 2009). Some bugs can tolerate environmental conditions that would be lethal to other invertebrate species, while others show less tolerance (Gooderham and Tsyrlin, 2002; Karaouzas and Gritzalis, 2006). In this study, a total of 21 heteropteran species were identified in the Park. This number represents about 38% of the total number of heteropteran species recorded in the Community of Madrid (García-Avilés, 2002b). During the study period, Corixidae was the most abundant family (about 98% of the total heteropterans abundance). It is often among the most common aquatic insects of ponds and shallow lakes, and some species are highly tolerant of pollution (McCafferty, 1998). However, *Micronecta scholtzi* (Corixidae) was the most abundant and common species accounting for 97% of the total Heteroptera abundance and found in 14 stations. *M. scholtzi* was clearly abundant in the non-vegetated habitats of large-sized wetlands, and these results agreed with the results of García-Avilés *et al.* (1996), Karaouzas and Gritzalis (2006) and Gogala (2009). *Micronecta scholtzi* can tolerate eutrophic conditions (Gutiérrez-Cánovas *et al.*, 2008). Another species appeared to be relatively common but little abundant in the Park was *Mesovelia vittigera*. It was recorded in 7 wetlands and appeared associated with cattails. In general this species can live in both freshwater and brackish-water habitats (Yang *et al.*, 1999).

One of the most notable heteropteran species in the Park was *Sigara selecta,* which recorded during the study period by García-Avilés, (2002b). The presence of this species was restricted to Rivas 1 (station 13) which has the highest salinity within the Park (7.90-12.28 mS/cm) (Alvarez Cobelas *et al.*, 2000). This species is adapted to colonize hypersaline salt basins (Millán *et al.*, 2001; Sánchez-Fernández *et al.*, 2007).

Beetles are an important part of most aquatic ecosystems. They occur as larvae, adults, or both in a wide variety of aquatic and semiaquatic environments (McCafferty, 1998). However, with the exception of the Elmidae, beetles have not been used extensively for water quality evaluation. This is due in large part to the fact that most water beetle adults, with the exception of the elmids and some adults of dryopids, are surface air-breathers and do not depend on dissolved oxygen in water for respiration (Epler, 1996). In this study, a total of 41 coleopteran species were identified in the Park. This number represents about 7% of the total number of the Iberian Coleoptera, which estimated by Ribera *et al.,* (1998) to be 622 coleopteran species. During this investigation, it was clearly that the highest abundance and richness were recorded in the Boyeriza Spring (station 84). It is the unique natural habitat within the studied habitats of the Park. Their water is calcium sulphate and is relatively saline (3.77-4.58 mS/cm) and has high concentrations of phosphorus (Alvarez Cobelas *et al.*, 2000). The high abundance of Coleoptera in Boyeriza Spring (station 84) and in the Park was mainly due to the high abundance of *Helophorus brevipalpis* (Helophoridae), which constitutes about 73% of the total abundance of Coleoptera in Boyeriza Spring (station 84) and about 54% of the total abundance of Coleoptera in the Park. This species can live in fresh to moderately brackish water bodies (Sánchez-Fernández *et al.,* 2007). *Hydroporus pubescens* (Dytiscidae) was the second dominant coleopteran species within Boyeriza Spring (station 84) and within the Park, followed by *Haliplus lineatocollis* (Haliplidae) and the two species can found in fresh to moderately brackish water bodies (Franciscolo, 1979; Sánchez-Fernández *et al.,* 2007). Regarding Adults of Coleoptera, *Helochares lividus* was the most frequent in the Park, where it was recorded in 7 stations. On the other hand, larvae of *Helochares* sp. and *Laccophilus* sp. were the most abundant and frequent in the Park (recorded in 11 and 8 stations, respectively).

One of the most notable coleopteran species in the Park was *Hydroglyphus signatellus*. The presence of this species was restricted only to Rivas 1 (station 13) which has the highest salinity within the Park (Alvarez Cobelas *et al.*, 2000). This is a seemingly good flying species (Ribera *et al.,* 1996a). It is mainly a costal species, although widespread in other arid areas in Central Spain (Ribera and Aguilera, 1995;

Ribera *et al.,* 1996b). It is a species characteristic of highly mineralized water, usually with elevated temperatures (Ribera and Aguilera, 1995).

Caddisflies (Trichoptera) are a diverse and vital biotic component of freshwater ecosystems, having been able to adapt and succeed in nearly every type of aquatic habitat (Pescador *et al.,* 2004). Many caddisfly larvae are quite sensitive to water quality, and for this reason, they are excellent indicators of water quality (Gooderham and Tsyrlin, 2002). During this investigation, *Ecnomus deceptor* was the relatively frequent (recorded in 5 stations) but not abundant in the Park (when present, no more than 1 individual/0.3 m^2). It is a species able to tolerate quite eutrophic conditions (González del Tánago and García de Jalón, 1984; Bonada, 2003).

Aquatic Diptera are a large and diverse group of insects which we know commonly under the names of flies, midges, and mosquito (Wirth and Stone, 1956). Because aquatic Diptera are to be found in many different ecological niches in both clean and polluted water and many species are highly selective in their choice of habitat, they constitute one of the most important groups of indicator organisms (Paine and Gaufin, 1956). Of all taxonomic groups recorded in the Park, Diptera dominated with about 63% of the total macroinvertebrate abundance. It was clearly abundant in Soto de Las Cuevas (station 107) with about 386 individuals/0.3 m^2, followed by San Martín de la Vega (station 92) with about 291 individuals/0.3 m^2. A total of 13 families of Diptera were identified. Chironomidae was by far the most common (recorded in all stations) and abundant family of Diptera (95 % of the total abundance of Diptera) and it considers the most abundant family in the Park (60% of the total macroinvertebrate abundance in the Park). As mentioned previously, Chironomidae is usually the most abundant macroinvertebrate group in numbers of species and individuals, encountered in the majority of freshwater aquatic habitats (Armitage *et al.,* 1995; Epler, 1995; van der Valk, 2006). Chironomidae was appeared to prefer a number of habitats, vegetated or non-vegetated. Other families, such as Ceratopogonidae, Limoniidae, Psychodidae and Stratiomyidae were recorded in about 25% of the study stations. These families appear to occur in a range of habitats, where they appeared abundant in the non-vegetated habitats (Ceratopogonidae and Stratiomyidae) or habitats vegetated with cattails (Limoniidae and Psychodidae). These families were known to be indicators of various types of pollution (Tchounwou, 1999; Gooderham and Tsyrlin, 2002).

7

CONCLUSION

7. CONCLUSIONS

- In the present study, the numeric taxonomic composition of the collected macroinvertebrates was: 9 classes, 13 orders, 51 families, 64 genera and 88 species.
- 51 species appear to be new records for the Park; 8 of them appear to be new records for the Community Madrid.
- Ephemeroptera was represented by 2 families, 2 genera and 3 species. *Cloeon inscriptum* and *Cloeon schoenemundi* were found new records for the Park.
- Odonata was represented by 5 families, 15 genera and 21 species. *Lestes dryas*, *Aeshna mixta* and *Selysiothemis nigra* were found new records for the Park.
- Heteroptera was represented by 8 families, 14 genera and 21 species. *Corixa panzeri*, *Heliocorisa vermiculata*, *Plea minutissima minutissima* and *Gerris* (*Gerriselloides*) *lateralis* were found new records for the Park.
- Coleoptera was represented by 10 families, 31 genera and 41 species. 40 species were found new records for the Park; 8 of them appear to be new records for the Community of Madrid.
- Trichoptera was represented by 4 families, 2 genera and 2 species. *Orthotrichia angustella* and *Ecnomus deceptor* were found new records for the Park.
- Diptera was identified to family-level only, and represented by 13 families (Ceratopogonidae, Chaoboridae, Chironomidae, Culicidae, Dixidae, Dolichopodidae, Empididae, Limoniidae, Psychodidae, Stratiomyidae, Syrphidae, Tabanidae and Tipulidae).
- Insects dominated the macroinvertebrate assemblage, either in the number of identified taxa (104 from 110 taxa collected from the Park, i.e. 94.5 %) or quantitatively (69015 from 74970 individuals, i.e. 92%).
- The habitats vegetated with cattails supported the highest macroinvertebrate abundance (223 individuals/0.3 m^2), followed by charophytes (209 individuals/0.3 m^2), non-vegetated habitats (206 individuals/0.3 m^2) and reeds (160 individuals/0.3 m^2).

- The highest taxa richness was recorded in the habitats vegetated with cattails (70% of total taxa richness) followed by non-vegetated habitats, reeds and charophytes with about 67, 43 and 14% of total taxa richness.
- Diptera was the dominant order in all the sampling stations of the Park except in San Antonio 5 (station 34) and Boyeriza Spring (station 84), where Heteroptera and Coleoptera were the dominant groups, respectively.
- The highest average abundance of individuals was recorded in Soto de Las Cuevas (station 107) (571 individuals/0.3 m^2), followed by Boyeriza Spring (station 84) and San Martín de la Vega (station 92) with about 365 and 352 individuals/0.3 m^2, respectively. On the other hand, the lowest average abundance was recorded in San Antonio 5 (station 34) and El Porcal 9 (station 47) with about 49 and 55 individuals/0.3 m^2, respectively.
- Taxa richness was ranged from 16 (14.5%) to 36 taxa (32.7%). The lowest taxa richness was observed in Henares River Dam 1 (station 7) and Tierno Galván Park (station 93), while the highest taxa richness was observed in Boyeriza Spring (station 84) and Soto de Las Cuevas (station 107).
- Shannon diversity index values were varied among the study stations. The highest value of 2.69 was recorded in Boyeriza Spring (station 84), while the lowest value of 0.96 was recorded in Henares River Dam1 (station 7).
- Taxa evenness was ranged from 0.24 (Henares River Dam 1; station 7) to 0.6 (Muñoz; station 57).
- Henares River Dam 1 (Station 7) has the highest percentage abundance of Chironomidae (82.56%), while the lowest percentage of 3.84% was recorded in Boyeriza Spring (station 84).
- The non-vegetated habitats of Soto de Las Cuevas (station 107) has the highest average abundance of macroinvertebrates (866 individuals/0.3 m^2).
- The highest values of taxa richness 36 (32.7%) and 34 taxa (30.9%) were recorded in the non-vegetated habitat of Boyeriza Spring (station 84) and in the habitats vegetated with cattails in Los Frailes (station 118), respectively. The lowest values of

4- 8 taxa (3.6 - 7.3%) were recorded in the non-vegetated habitats of El Porcal (station 47) and San Antonio 5 (station 34), and habitats vegetated with reeds in Tierno Galván Park (station 93).

- The highest values of Shannon diversity index (2.69 and 2.68) were recorded in the non-vegetated habitats of Boyeriza Spring (station 84) and in the habitats vegetated with cattails in Las Madres 3 (station 51), respectively. The lowest values (0.61 and 0.62) were recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104), respectively.
- The highest value of taxa evenness (0.69) was recorded in the non-vegetated habitat of Las Madres 1 (station 49), while the lowest values were recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104).
- The highest percentage abundance values of Chironomidae (91.5 and 91.6 %) were recorded in the habitats vegetated with cattails in Henares River Dam 1 (station 7) and Ciempozuelos 1 (station 104), respectively. The lowest percentage abundance of Chironomidae (3.8%) was recorded in the non-vegetated habitats of Boyeriza Spring (station 84).
- The Jaccard index value between Las Madres 1 (station 49) and Las Madres 3 (station 51) was the highest, while it was the lowest for the comparison between Boyeriza Spring (station 84) and Muñoz (station 57).
- The highest average abundance of Ephemeroptera (49 individuals/0.3 m^2) was recorded in Henares River Dam 2 (station 8). *Caenis luctuosa* was the most abundant (2364 individuals) and frequent (recorded in 10 stations) ephemeropteran species in the Park, and appears to prefer non-vegetated habitats.
- The highest average abundance of Odonata (35 individuals/0.3 m^2) was recorded in Henares River Dam 2 (station 8). *Ischnura* sp. was the most abundant (678 individuals) and frequent (recorded in all the study stations) species of Odonata in the Park, and appears to prefer the habitats vegetated with cattails.
- Heteroptera was clearly abundant in Soto de Las Cuevas (station 107) with about 107 individuals/0.3 m^2. *Micronecta scholtzi* was the most abundant (9775 individuals)

and frequent (recorded in 14 stations) heteropteran species in the Park, and appears to prefer the non-vegetated habitats.

- Coleoptera was by far more abundant in Boyeriza Spring (station 84) (246 individuals/0.3 m^2). *Helophorus brevipalpis* was the most abundant species of Coleoptera in the Park (1089 individuals), while *Helochares lividus* was the most frequent (recorded in 7 stations). *Helophorus brevipalpis* was by far more abundant in the non-vegetated habitats, while *Helochares lividus* appears to occur in the habitats vegetated with reeds and cattails.
- The presence of Trichoptera within the Park was very rare. *Ecnomus deceptor* was relatively frequent (recorded in 5 stations) but not abundant in the Park.
- Diptera was clearly abundant in Soto de Las Cuevas (station 107) with about 386 individuals/0.3 m^2. Chironomidae was by far the most abundant (44849 individuals) and frequent (recorded in 17 stations) family of Diptera in the Park, and appears to occur in both vegetated and non-vegetated habitats.
- Of the 88 aquatic insect species recorded in the study stations of the Park, 18 species (more than 20%) have been found exclusively in Boyeriza Spring (station 84). This station was the unique natural habitat within the studied habitats of the Park.
- 28 aquatic insect species (about 32% of the total species recorded in the Park) have been found exclusively in the shallowest wetlands of the Park (with less than 1 m depth); Rivas 1 (station 13), Boyeriza Spring (station 84) and Los Frailes (station 118).

8

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APPENDICES

APPENDIX 1

PHYSICAL AND CHEMICAL CHARACTERS OF THE STUDY STATIONS OF THE SOUTHEAST REGIONAL PARK DURING THE STUDY PERIOD BASED ON ALVAREZ COBELAS *ET AL.* (2000)

Table (1): Physical and chemical characteristics of the study stations of the Southeast Regional Park during October 1998.

Parameters / [illegible]	7	[illegible]	15	[illegible]	47	[illegible]	51	[illegible]	67	[illegible]	[illegible]	[illegible]	[illegible]	93	104	107	[illegible]
% cobbles	0	0	0	0	0	60	30	5	10	0	0	0	80	0	20	20	0
% Gravel	5	10	0	0	5	20	30	5	30	0	0	0	0	0	30	60	0
% Fine gravel	5	30	0	50	5	10	30	5	30	0	0	0	0	50	20	20	0
% Sand	0	40	0	50	90	10	10	85	30	0	0	0	0	50	20	0	0
% Silt	90	20	100	0	0	0	0	0	0	100	100	100	20	0	10	0	100
Transparency (m)	0,25	1,3	Shallow	0,3	0,45	3,8	3	6,2	4,5	0,85	-	Shallow	0,1	0,9	6,2	0,8	Shallow
Temperature (°C)	10,2	12	13,1	16,5	18	15,2	14,6	15,6	17,1	14,8	-	12,3	12,4	14,5	15,6	14	12,1
Dissolved Oxygen (mg/L)	12,8	5	10,5	9	11,1	5,6	6,7	7,7	7,3	4,5	-	14,2	13	7,6	7,7	8,5	2,9
pH	8,26	7,86	8,81	7,98	8,74	7,4	7,98	7,62	7,98	8	-	8,1	8,53	7,7	7,62	8,07	7,39
Electrical Conductivity (uS/cm)	3150	5360	11340	1525	2520	2590	2680	3140	2320	2080	-	2630	1894	1872	3140	4800	3080
Total Solids (mg/L)	2596	4572	10668	1204	1836	2100	2172	2844	1952	1744	-	1384	1472	1632	2844	3772	2668
Suspended Solids (mg/L)	37,5	34	721,2	10	19,2	2	2,4	4	4,4	29,2	-	2,4	113	5,2	4	12	4
Silica (mg/L)	5,89	12,6	1,9	11,46	11,1	12,5	12,1	13,6	7,65	12,7	-	37,7	21,7	14,1	13,6	3,46	35,3
Nitrate (mg/L)	0	3,95	0,62	0	8,42	11,23	8,11	4,47	9,15	1,31	-	24,33	16,43	7,49	4,47	0	2,6
Nitrite (mg/L)	0,001	0,302	0,011	0,011	0,245	0,047	0,072	0,044	0,096	0,064	-	0,146	0,132	1,408	0,044	0,132	0,313
Ammonium (mg/L)	0,005	0,46	0,39	0,17	1,18	0,09	0,2	0,25	0,42	1,13	-	0,028	0,17	1,47	0,25	0,17	0,12
Total Nitrogen (mg N/L)	8,81	5,25	3,9	2,24	6,6	3,41	2,92	3,66	2,98	2,24	-	8,57	18,51	4,88	3,66	1,43	5,38
Orthophosphate (mg/L)	0,796	0,018	0,036	0,094	0,909	0,007	0,014	0,004	0,015	0,028	-	0,077	1,258	0,013	0,004	0,439	0,02
Total phosphorus (mg P/L)	0,667	0,076	0,082	0,042	1,56	0,043	0,043	0,038	0,034	0,101	-	0,15	5,09	0,26	0,038	1,121	0,169
Organic matter (mg O2/L)	36,7	10,6	18	16,3	18,8	9,8	8,9	18	4,9	12,2	-	4,9	66,1	10,6	18	19,6	6,5
Chlorophyll "a" (µg/L)	446	16	12	111	230	6,7	17	2,5	4,1	13	-	42	474	88	2,5	203	31

Table (2): Physical and chemical characteristics of the study stations of the Southeast Regional Park during February 1999.

Parameters / Stations	7	8	13	35	47	49	51	55	57	[illegible]	84	85	92	93	104	107	118
% cobbles	0	0	0	0	0	60	30	5	10	0	0	0	80	0	20	20	0
% Gravel	5	10	0	0	5	20	30	5	30	0	0	0	0	0	30	60	0
% Fine gravel	5	30	0	50	5	10	30	5	30	0	0	0	0	50	20	20	0
% Sand	0	40	0	50	90	10	10	85	30	0	0	0	0	50	20	0	0
% Silt	90	20	100	0	0	0	0	0	0	100	100	100	20	0	10	0	100
Transparency (m)	0,57	1,55	Shallow	0,55	0,12	3,5	4,5	8,4	11,7	1,85	Shallow	Shallow	0,33	1	0,6	0,65	Shallow
Temperature (°C)	11,3	8,8	12,1	10,2	12,2	9,3	11	10,9	10,1	11,9	11,6	14,4	15,9	14,2	13,9	15,7	13
Dissolved Oxygen (mg/L)	3,7	10,1	9,3	12,1	19,8	14,8	10,5	12	10,7	10,4	11	10,3	21,5	13	22,1	12,2	5,7
pH	7,91	8,1	8,83	8,5	9,25	8,1	8,3	8,21	8,3	8,39	7,91	8,19	8,59	8,17	8,61	8,29	7,82
Electrical Conductivity (µS/cm)	2830	5875	12280	1475	2340	2430	2480	2910	2090	1882	4580	2580	1900	1704	1916	4270	2720
Total Solids (mg/L)	2798	5554	11548	1449	2267	1833	2346	2590	1770	1831	4037	2497	1418	1208	1840	4152	2369
Suspended Solids (mg/L)	19	20	119	16	29	29	10	3	28	7	108	61	57	30	31	28	20
Carbon dioxide (mg/L)	2,2	0,4	0,05	0,1	0	0,5	0,4	0,3	0,2	0,1	1,1	0,5	0,06	0,3	0,05	0,4	1,3
Bicarbonates (mg/L)	261	476	139	235	232	185	226,01	226,01	316	327	748	214	267	327	130	125	298
Carbonates (mg/L)	0	0	51,3	5,7	19,95	2,85	0	5,7	2,85	14,25	5,7	5,7	0	0	0	0	5,7
Sulphates (mg/L)	993	2064	3910	431	1201	682	777	1221,1	913	577	1406	1263	817	580	525	1270,8	1266
Chlorides (mg/L)	343	1151	3022	246	239	281	316	155	351	155	225	112	49	155	176	518	197
Sodium (mg/L)	393	780	177	172	513	212	276	209	355	313	276	107	233	196,01	123	404	317
Potassium (mg/L)	30,8	38,6	130,2	25,9	19,1	24	30,5	27,4	33,7	26,2	11,3	6,6	18,2	10,6	7,4	8,4	13,7
Calcium (mg/L)	50	370	250	120	200	160	200	310	220	130	340	360	210	160	220	440	230
Magnesium (mg/L)	188	358	1792	67	48	97	85	115	85	67	133	236	24,2	61	24	36	140
Silica (mg/L)	4,6	5,9	4	6,9	16,2	7	6,5	10,4	8,7	7,5	16,3	13,3	1,8	5,7	8,2	2,8	16,2
Nitrate (mg/L)	1,25	0,41	6,66	1,04	0,96	7,28	6,66	4,47	7,69	2,29	0,93	17,2	5,6	8,1	1,35	0,41	5,2
Nitrite (mg/L)	0,026	0,514	0,163	0,147	0,3554	0,031	0,027	0,042	0,136	0,126	0,017	0,011	0,468	0,398	0,556	0,015	0,022
Ammonium (mg/L)	0,376	0,09	0,12	0,238	0,321	0,202	0,097	0,407	0,184	0,56	0,09	0,186	0,275	0,237	0,225	0,21	0,9
Total Nitrogen (mg N/L)	2,62	3,66	7,35	2,43	4,7	1,55	1,48	3,04	4,39	3,67	4,39	14,72	7,71	8,02	6,48	2,25	5,5
Orthophosphate (mg/L)	0,65	0,023	0,031	0,236	1,01	0,018	0,01	0,014	0,044	0,013	0,215	0,04	0,2	0,02	0,11	0,087	0,058
Total phosphorus (mg P/L)	1,4	0,07	0,099	0,686	1,26	0,03	0,029	0,035	0,069	0,068	0,236	0,206	0,847	0,111	0,487	0,194	0,26
Organic matter (mg O2/L)	34,8	13,2	14	15,7	48,1	9	10,7	20,7	6,5	8,2	14	9,9	27,3	9	16,5	14,8	14,9
Chlorophyll "a" (µg/L)	148	17	16	70	517	5,1	4,8	2,3	5,8	8	56	21	238	20	314	111	60

Table (3): Physical and chemical characteristics of the study stations of the Southeast Regional Park during May 1999.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
% cobbles	0	0	0	0	0	60	30	5	10	0	0	0	80	0	20	20	0
% Gravel	5	10	0	0	5	20	30	5	30	0	0	0	0	0	30	60	0
% Fine gravel	5	30	0	50	5	10	30	5	30	0	0	0	0	50	20	20	0
% Sand	0	40	0	50	90	10	10	85	30	0	0	0	0	50	20	0	0
% Silt	90	20	100	0	0	0	0	0	0	100	100	100	20	0	10	0	100
Transparency (m)	0,3	0,6	Shallow	0,6	0,3	3,1	5	2,2	4	2,5	Shallow	Shallow	0,3	2	0,55	3,6	Shallow
Temperature (°C)	18,1	15,3	17	19,3	17,7	17,3	17,2	17,3	17.8	19,1	11,3	14,2	15,7	17,9	16,2	17,4	15
Dissolved Oxygen (mg/L)	26,3	14,8	14,8	15,4	19,2	12,2	11,4	13,7	13.8	11,3	8,8	12,6	23,4	14,5	12,6	8,8	7,8
pH	8,42	8,09	9,08	8,55	9,08	8,29	8,04	8,3	8,09	8,21	7,75	8,13	8,35	8,04	8,32	7,49	7,6
Electrical Conductivity (µS/cm)	2900	4640	7900	1595	2460	2470	2580	2990	2180	1963	4280	2400	1663	1755	1931	5660	2940
Total Solids (mg/L)	2284	3752	4384	1236	1669	2065	2529	2690	1736	1338	3859	2339	1650	1268	1441	4111	2437
Suspended Solids (mg/L)	45	26	294	21	43	18	16	3	9	21	166	18	29	9	20	27	24
Silica (mg/L)	4	0,9	1,6	5,4	13,4	7,79	4,29	10,3	5,64	2,4	13,2	2,1	4	8,1	14,6	6,7	12,9
Nitrate (mg/L)	1,23	0,62	6,24	1,25	1,02	6,66	6,24	3,95	2,08	2,08	0,83	17,1	5,2	0,6	1,29	0,37	4,57
Nitrite (mg/L)	0,018	0,217	0,005	0,008	0,056	0,032	C,03	0,042	0,092	0,089	0,025	0,332	0,129	0,318	0,439	0,143	0,203
Ammonium (mg/L)	0,39	0,31	0,499	0,039	0,058	0,11	0,387	0,071	0,02	0,479	0,276	0,4	0,49	0,68	0,559	3,517	0,879
Total Nitrogen (mg N/L)	6,69	5,61	5,15	1,5	6,07	1,78	0,79	1,34	3,93	9,76	5,15	10,37	6,01	10,37	8,53	7,3	4,54
Orthophosphate (mg/L)	0,184	0,046	0,046	0,02	0,139	0,028	0,032	0,079	0,004	0,013	0,047	0,073	0,44	0,004	0,092	0,55	0,028
Total phosphorus (mg P/L)	0,981	0,159	0,066	0,359	0,655	0,04	0,038	0,082	0,01	0,052	0,187	0,168	0,795	0,075	0,446	0,82	0,14
Organic matter (mg O2/L)	35,7	19,8	16,5	14,9	23,2	9	12,4	15,7	5,7	5,7	14	9	44,8	8,2	22,3	19	12,4
Chlorophyll "a" (µg/L)	17	64	10	57	197	9,7	6,1	7	19	10	25	19	486	21	243	76	46

Table (4): Physical and chemical characteristics of the study stations of the Southeast Regional Park during July 1999.

[illegible]	7	[illegible]	11	[illegible]	[illegible]	40	[illegible]	[illegible]	57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
% cobbles	0	0	0	0	0	60	30	5	10	0	0	0	80	0	20	20	0
% Gravel	5	10	0	0	5	20	30	5	30	0	0	0	0	0	30	60	0
% Fine gravel	5	30	0	50	5	10	30	5	30	0	0	0	0	50	20	20	0
% Sand	0	40	0	50	90	10	10	85	30	0	0	0	0	50	20	0	0
% Silt	90	20	100	0	0	0	0	0	0	100	100	100	20	0	10	0	100
Transparency (m)	0,5	0,55		0,6	0,4	4	3,7	2,3	5	1,3	-	-	0,7	1,25	0,45	2	-
Temperature (°C)	30,8	28,6		27	25,9	28,2	25,4	27,1	24,8	25,6	-	-	28,3	24,4	23,8	25,2	-
Dissolved Oxygen (mg/L)	15,6	10,1		10	14,4	8,4	9,6	12,4	9,1	9,5	-	-	12,5	17,2	10,1	10,7	-
pH	8,08	7,61		8,27	9,06	7,82	7,89	9,17	7,64	7,53	-	-	7,7	7,87	8,58	7,89	-
Electrical Conductivity (µS/cm)	2820	4400		1508	2290	2470	2390	3070	1877	1917	-	-	2030	1785	1874	5980	-
Total Solids (mg/L)	2805	4351		1150	1867	2007	2172	3000	1678	1544	-	-	1576	1419	1547	5074	-
Suspended Solids (mg/L)	36	20,4		9,6	22	1,4	1	4,4	0,6	1,6	-	-	7,6	6,8	13,2	3	-
Sulphates (mg/L)	1134	1342		423	603	710	796	1620,7	599	533	-	-	538	462	560	1554	-
Nitrate (mg/L)	1,25	0,56		1,14	0,98	6,24	5,62	3,53	1,97	1,97	-	-	4,89	0,52	1,25	0,41	-
Nitrite (mg/L)	0,003	0,018		0,003	0,003	0,015	0,008	0,008	0,083	0,042	-	-	0,301	0,3111	0,012	0,348	-
Ammonium (mg/L)	0,413	0,176		0,315	0,265	0,029	0,024	0,1276	0,004	0,004	-	-	0,088	0,009	0,31	0,621	-
Total Nitrogen (mg N/L)	7,18	2,88		2,45	4,23	1,19	0,67	1,35	4,54	1,04	-	-	6,69	9,14	7,11	9,29	-
Orthophosphate (mg/L)	0,293	0,055		0,06	0,184	0,009	0,009	0,0323	0,0021	0,009	-	-	0,142	0,06	0,139	0,489	-
Total phosphorus (mg P/L)	0,503	0,196		0,43	0,562	0,029	0,023	0,0565	0,0155	0,034	-	-	0,187	0,28	0,757	0,941	-
Chlorophyll "a" (µg/L)	167	46		33	104	10	12	24	7	38	-	-	89	36	121	42	-

APPENDIX 2

STUDY STATIONS OF THE SOUTHEAST REGIONAL PARK


Henares River Dam 1 (Station 7)


Henares River Dam 2 (Station 8)


Rivas 1 (Station 13)


San Antonio 5 (Station 34)

El Campillo 1 (Station 35)

El Porcal 9 (Station 47)

Las Madres 1 (Station 49)

Las Madres 3 (Station 51)

Camping Lagos 1 (Station 55)

Muñoz (Station 57)

Villafranca (Station 58)

Boyeriza Spring (Station 84)

Gózquez Reservoir (Station 85)

San Martin de La Vega 7 (Station 92)

Tierno Galván Park (Station 93)

Ciempozuelos 1 (Station 104)


Soto de Las Cuevas (Station 107)


Los Frailes (Station 118)

APPENDIX 3

AQUATIC MACROINVERTEBRATES COLLECTED AND OBSERVED IN THE SOUTHEAST REGIONAL PARK DURING THE STUDY PERIOD

Table (1.1): Aquatic macroinvertebrates collected from stations 7, 8 and 13 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Dugesiidae															
Oligochaeta	15	246	70	29	25	14	2	1	3	8	3	6			
Glossiphoniidae															
Cambaridae		1					6	17	1	6	4	2			
Atyidae															
Trombidiformes											1				
Baetidae					5		95	205	84	63	86	20	1		
Cloeon inscriptum															
Cloeon schoenemundi															
Caenis luctuosa								1							
Coenagrionidae		1	4		4	2	29	69	27	38	34	2	8	43	6
Ischnura sp.							11								
Erythromma lindenii															
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
Sympecma sp.															
Platycnemis sp.											1				
Aeshnidae							2	1	3	4	1		1	1	2
Aeshna mixta															
Anax imperator															
Anax parthenope															
Anax sp.															
Libellulidae								2			2			1	
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.															
Selysiothemis nigra															
Symptrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi			28	1			1	1	1	10	3	23			
Sigara lateralis													1		
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.															
Agabus nebulosus															
Agabus sp.															
Hydroglyphus geminus															
Hydroglyphus signatellus													3		2
Hydroporus nigrita															

Table (1.1): (Continued).

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus								1							
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.														2	
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus														1	
Berosus sp.														2	
Coelostoma sp.															
Helochares lividus															
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae	1	7	13	2							2	2	4	3	3
Chaoboridae															
Chironomidae	18	94	265	24	112	58	76	266	165	109	131	698	33	78	17
Culicidae									1						
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae				1	1		2	5	4			1			
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (1.2): Aquatic macroinvertebrates collected from stations 35 and 47 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat, E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3
Dugesiidae															
Oligochaeta	10	3		25	2	9	28	14	2	2	1	35		1	3
Glossiphoniidae	2			1				1							
Cambaridae															
Atyidae															
Trombidiformes				6		1	1								
Baetidae	21	5	2	4		4		2							
Cloeon inscriptum															
Cloeon schoenemundi															
Caenis luctuosa	19	9	5	1	1	2	18	28	27						
Coenagrionidae	37	6	4	32	7	16	125	5	1						
Ischnura sp.		1													
Erythromma lindenii															
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
Sympecma sp.															
Platycnemis sp.		5	2	3	1										
Aeshnidae	3	1	2	2		1									
Aeshna mixta															
Anax imperator															
Anax parthenope															
Anax sp.															
Libellulidae						1									
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.															
Selysiothemis nigra															
Sympetrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi	13	3	13	80	110	110	788	329	109	5	2		5	36	8
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.															
Agabus nebulosus															
Agabus sp.															
Hydroglyphus geminus															
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (1.2): (Continued).

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.															
Coelostoma sp.															
Helochares lividus															
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor	1														
Ceratopogonidae									1						
Chaoboridae															
Chironomidae	142	52	36	95	26	106	80	42	20	8	3	3	9	3	
Culicidae															
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae		4								1					
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (1.3): Aquatic macroinvertebrates collected from stations 49, 51 and 55 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3
Dugesiidae				1														
Oligochaeta	15	2	3	10	2	5	7	2	50	6	20		16		18	75	8	67
Glossiphoniidae																		
Cambaridae	4		1	10		1		1	5	2	1	25	5	4	1	3	3	1
Atyidae	3	2	2		5		2		5	2		1						
Trombidiformes								1		7	13	13	1	4	1			
Baetidae		6	1	7	10	18	1	2	6	3	9	5	5		1	1	2	
Cloeon inscriptum																		
Cloeon schoenemundi																		
Caenis luctuosa	1		16		12	3	2		1		3	9	1	1		8	114	
Coenagrionidae		1	3	4	10	6	10	16	18	24	30	24	21	14	18	1		6
Ischnura sp.												2						
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
Sympecma sp.																		
Platycnemis sp.						1	3		1	1		7		2	1			
Aeshnidae														1				
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
Anax sp.																		
Libellulidae								1		2	3	2		6	4			
Crocothemis erythraea																		
Orthetrum cancellatum																		
Orthetrum sp.																		
Selysiothemis nigra																		
Sympetrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi	1	1									2					18	37	12
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
Gerris sp.																		
Mesovelia vittigera																		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
Notonecta sp.																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
Dryops sp.																		
Agabus nebulosus																		
Agabus sp.																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (1.3): (Continued).

Code/Habitat/Replica	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.								1										
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																	1	
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor			2			1	1											
Ceratopogonidae														1				
Chaoboridae															3			
Chironomidae	6	28	15	62	147	51	19	6	39	40	139	4	5	4	6	22	35	6
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae				11	2		3	10	11				4					
Psychodidae																		
Stratiomyidae																		
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (1.4): Aquatic macroinvertebrates collected from stations 57, 58 and 92 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	57C1/3	57C2/3	57C3/3	57L1/3	57L2/3	57L3/3	57E1/3	57E2/3	57E3/3	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	92E1/3	92E2/3	92E3/3
Dugesiidae																		
Oligochaeta	2	2	2	4	3	5	13	2			4		1			68	28	
Glossiphoniidae																		
Cambaridae	1		1	3	2			2	4	2	1	8	1				1	1
Atyidae				12			2	5										
Trombidiformes											1		1	2	1			
Baetidae	2	4	2	7	101	27	1	5	5		13	1	4	1	1		1	11
Cloeon inscriptum																		
Cloeon schoenemundi																		
Caenis luctuosa	4	29	1	52	148	54	1	5	20					1				
Coenagrionidae	10	5	17		11		15	9	12	12	28	14			5	13	6	9
***Ischnura* sp.**										14	15					12		1
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**											1							
Aeshnidae		1			1			1		4	10	1						
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
***Anax* sp.**																		
Libellulidae					5								2					
Crocothemis erythraea																		
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra																		
Sympetrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi			2		1						1				1	14	3	3
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera										1							1	
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (1.4): (Continued).

Code/Habitat/Replica	57C1/3	57C2/3	57C3/3	57L1/3	57L2/3	57L3/3	57E1/3	57E2/3	57E3/3	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	92E1/3	92E2/3	92E3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae					1													
Ecnomus deceptor				3				4										
Ceratopogonidae	33	3	46	16	454	220	11	5	6				1		5		5	
Chaoboridae																		
Chironomidae	28	146	145	29	139	112	111	221	68	55	20	14	139	111	29	181	40	48
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae	1									3	6	12			1	1	4	6
Psychodidae																		
Stratiomyidae																		
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (1.5): Aquatic macroinvertebrates collected from stations 93 and 104 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	93C1/2	93C2/2	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Dugesiidae														
Oligochaeta	32	28	42	13	31	35	91	89	13	2	11	25	9	18
Glossiphoniidae			5										32	1
Cambaridae			1				4	1	1					
Atyidae														
Trombidiformes														
Baetidae	1	2	1					1					4	
Cloeon inscriptum														
Cloeon schoenemundi														
Caenis luctuosa		1	1											
Coenagrionidae	14	8	7		1	2	1	16	6	3	10	1		
Ischnura sp.							2							
Erythromma lindenii														
Erythromma viridulum														
Lestidae														
Lestes dryas														
Lestes viridis														
Sympecma sp.														
Platycnemis sp.	1	2									1			
Aeshnidae									1		1			
Aeshna mixta														
Anax imperator														
Anax parthenope														
Anax sp.														
Libellulidae								1						
Crocothemis erythraea														
Orthetrum cancellatum							1							
Orthetrum sp.														
Selysiothemis nigra														
Sympetrum fonscolombei														
Trithemis annulata														
Corixidae														
Corixa affinis														
Corixa panzeri														
Heliocorisa vermiculata														
Hesperocorixa linnaei														
Micronecta scholtzi					5				1	1	1	3	9	2
Sigara lateralis														
Gerris argentatus														
Gerris lateralis														
Gerris sp.														
Mesovelia vittigera														
Naucoris maculatus														
Nepa cinerea														
Anisops sardeus									1					
Notonecta sp.														
Plea minutissima														
Microvelia pygmaea														
Dryops luridus														
Dryops sp.														
Agabus nebulosus														
Agabus sp.														
Hydroglyphus geminus														
Hydroglyphus signatellus														
Hydroporus nigrita														

Table (1.5): (Continued).

Code/Habitat/Replica	93C1/2	93C2/2	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Hydroporus obsoletus														
Hydroporus pubescens														
Hydroporus sp.														
Hygrotus inaequalis														
Hygrotus sp.														
Laccophilus hyalinus														
Laccophilus minutus														
Laccophilus sp.														
Ilybius sp.														
Stictotarsus griseostriatus														
Rhantus suturalis														
Oreodytes sp.														
Hydrovatus cuspidatus														
Hydrovatus sp.														
Stictonectes lepidus														
Gyrinus sp.														
Haliplus lineatocollis														
Haliplus sp.														
Helophorus alternans														
Helophorus brevipalpis														
Helophorus aquaticus														
Helophorus flavipes														
Helophorus minutus														
Hydraena sp.														
Ochthebius sp.														
Anacaena globulus														
Berosus hispanicus														
Berosus sp.														
Coelostoma sp.														
Helochares lividus							1							
Helochares sp.														
Hydrobius fuscipes														
Laccobius sinuatus														
Laccobius sp.														
Hydroscapha sp.														
Noterus laevis														
Cyphon sp.														
Hydrocyphon sp.														
Orthotrichia angustella														
Limnephilidae														
Polycentropodidae														
Ecnomus deceptor														
Ceratopogonidae					1						1			
Chaoboridae														
Chironomidae	178	80	131	20	44	45	23	56	84	149	411	151	23	205
Culicidae														
Dixidae														
Dolichopodidae														
Empididae														
Limoniidae													1	
Psychodidae													22	
Stratiomyidae														
Syrphidae														
Tabanidae														
Tipulidae														

Table (1.6): Aquatic macroinvertebrates collected from stations 107 and 118 during October 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	118E1/3	118E2/3	118E3/3
Dugesiidae												
Oligochaeta	152	25	51	131	30	58		105	201	2		1
Glossiphoniidae												
Cambaridae									2			
Atyidae												
Trombidiformes												
Baetidae	1			1				1			2	1
Cloeon inscriptum												
Cloeon schoenemundi												
Caenis luctuosa	231	12	3	25	4	4			3			
Coenagrionidae			4	9	2	29	27	39	19	5	4	
Ischnura sp.												1
Erythromma lindenii												
Erythromma viridulum												
Lestidae												
Lestes dryas												
Lestes viridis												
Sympecma sp.												
Platycnemis sp.			3	2		9	6	17	10			
Aeshnidae		1					1				1	
Aeshna mixta												
Anax imperator												
Anax parthenope												
Anax sp.												
Libellulidae									2	2	1	
Crocothemis erythraea												3
Orthetrum cancellatum												
Orthetrum sp.												
Selysiothemis nigra												
Sympetrum fonscolombei												
Trithemis annulata												
Corixidae												
Corixa affinis												
Corixa panzeri												
Heliocorisa vermiculata												
Hesperocorixa linnaei										1		
Micronecta scholtzi	22	9	2	1			3					
Sigara lateralis												
Gerris argentatus												
Gerris lateralis												
Gerris sp.												
Mesovelia vittigera												1
Naucoris maculatus				2		1	1	1	1			
Nepa cinerea												
Anisops sardeus												
Notonecta sp.												
Plea minutissima												
Microvelia pygmaea												
Dryops luridus												
Dryops sp.												
Agabus nebulosus												
Agabus sp.												
Hydroglyphus geminus												
Hydroglyphus signatellus												
Hydroporus nigrita												

Table (1.6): (Continued)

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	118E1/3	118E2/3	118E3/3
Hydroporus obsoletus												
Hydroporus pubescens										2		
Hydroporus sp.												
Hygrotus inaequalis											1	
Hygrotus sp.												
Laccophilus hyalinus												
Laccophilus minutus												
Laccophilus sp.												
Ilybius sp.												
Stictotarsus griseostriatus												
Rhantus suturalis												
Oreodytes sp.												
Hydrovatus cuspidatus												
Hydrovatus sp.												
Stictonectes lepidus												
Gyrinus sp.												
Haliplus lineatocollis												
Haliplus sp.												
Helophorus alternans												
Helophorus brevipalpis												
Helophorus aquaticus												
Helophorus flavipes												
Helophorus minutus												
Hydraena sp.												
Ochthebius sp.												
Anacaena globulus												
Berosus hispanicus												
Berosus sp.												
Coelostoma sp.												
Helochares lividus												
Helochares sp.												
Hydrobius fuscipes												
Laccobius sinuatus												
Laccobius sp.												
Hydroscapha sp.												
Noterus laevis												
Cyphon sp.												
Hydrocyphon sp.												
Orthotrichia angustella												
Limnephilidae												
Polycentropodidae												
Ecnomus deceptor												
Ceratopogonidae										2		1
Chaoboridae												
Chironomidae	172	284	229	776	264	849	42	849	923	147	26	217
Culicidae												
Dixidae												
Dolichopodidae												
Empididae												
Limoniidae	21							12	1			
Psychodidae												
Stratiomyidae												
Syrphidae												
Tabanidae												
Tipulidae												

Table (2.1): Aquatic macroinvertebrates collected from stations 7, 8 and 13 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Dugesiidae															
Oligochaeta	5		5	10	5	9	2	4	5	3	6	8			
Glossiphoniidae															
Cambaridae	1		1	1		1	1	3	2	11		5			
Atyidae															
Trombidiformes															
Baetidae	1						13	191	192			23			
Cloeon inscriptum															
Cloeon schoenemundi										12					
Caenis luctuosa									1						
Coenagrionidae				2				12	31	9		9		9	3
Ischnura sp.					4			14	30	8	1	3		1	2
Erythromma lindenii															
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
Sympecma sp.															
Platycnemis sp.									1						
Aeshnidae								1	3						
Aeshna mixta															
Anax imperator									1						
Anax parthenope															
Anax sp.															
Libellulidae													1		1
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.														1	
Selysiothemis nigra															
Sympetrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi	4	1			1		2	2		9	34	9			
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.															
Agabus nebulosus															
Agabus sp.															
Hydroglyphus geminus															
Hydroglyphus signatellus													2		
Hydroporus nigrita															

Table (2.1): (Continued).

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.													4		
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															1
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes				1				1							
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.							1								
Anacaena globulus															
Berosus hispanicus															
Berosus sp.													1		
Coelostoma sp.															
Helochares lividus															
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae	1									1		1	95	9	7
Chaoboridae															
Chironomidae	206	58	134	132	263	188	186	292	290	192	234	139	69	65	28
Culicidae															
Dixidae															
Dolichopodidae															
Empididae			1												
Limoniidae				3	4	2					1				
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (2.2): Aquatic macroinvertebrates collected from stations 34 and 35 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	34C1/3	34C2/3	34C3/3	34L1/3	34L2/3	34L3/3	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3
Dugesiidae															
Oligochaeta				3	5	1	5	15	4	1	35	25		4	1
Glossiphoniidae											3	1			
Cambaridae															
Atyidae															
Trombidiformes															
Baetidae	21	7	23		4	5	1	2				33			
Cloeon inscriptum															
Cloeon schoenemundi															
Caenis luctuosa							2	1	2	4	1			1	
Coenagrionidae			4					2	3	4	1	22			
***Ischnura* sp.**	1	1	4				4	1	1	1		3			
Erythromma lindenii									1						
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
***Sympecma* sp.**															
***Platycnemis* sp.**			1									3			
Aeshnidae															
Aeshna mixta															
Anax imperator															
Anax parthenope															
***Anax* sp.**									1			1			
Libellulidae															
Crocothemis erythraea															
Orthetrum cancellatum															
***Orthetrum* sp.**															
Selysiothemis nigra															
Symptrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi		4	12	8	22	80	8	6	3	265	39	182	2	2	
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
***Gerris* sp.**															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
***Notonecta* sp.**															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
***Dryops* sp.**															
Agabus nebulosus															
***Agabus* sp.**					1										
Hydroglyphus geminus															
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (2.2): (Continued).

Code/Habitat/Replica	34C1/3	34C2/3	34C3/3	34L1/3	34L2/3	34L3/3	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus	1														
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.		1													
Stictotarsus griseostriatus															
Rhantus suturalis	1														
Oreodytes sp.			3			10									
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.	1														
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.															
Coelostoma sp.															
Helochares lividus															
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.				2											
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae															
Chaoboridae															2
Chironomidae		1	28	5	6	24	123	50	201	227	31	147	10	8	20
Culicidae															
Dixidae															
Dolichopodidae		1													
Empididae			2												
Limoniidae							2			1		7			
Psychodidae													1		
Stratiomyidae							1								
Syrphidae															
Tabanidae			1												
Tipulidae															

Table (2.3): Aquatic macroinvertebrates collected from stations 47, 49 and 51 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3
Dugesiidae																		
Oligochaeta	2	12			2	6	8	18	16	5	10	7	16	7	4	14		5
Glossiphoniidae																		
Cambaridae	1	1	1				2	4	1	5	1	6	1	13		5	5	6
Atyidae										4		2						
Trombidiformes														1		2		
Baetidae							1	2	1	38		32	32	13	1	8	51	34
Cloeon inscriptum																		
Cloeon schoenemundi											13			18				
Caenis luctuosa							5	10	6			2		5	1			2
Coenagrionidae			1					2	1	5	20	19	51	21	1	8	36	25
***Ischnura* sp.**			1					1	2	2	2	6	21	19		4	7	16
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**										1				1				3
Aeshnidae								1		2		2						1
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
***Anax* sp.**																		
Libellulidae																		
Crocothemis erythraea																		
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra													1					
Sympetrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi	197	14	45		4	13				1		1	2	10		5	4	8
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera																		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (2.3): (Continued).

Code/Habitat/Replica	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus			1															
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.													1					
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis			1															
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus	1																	
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.															1			
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae														1				
Polycentropodidae																		
Ecnomus deceptor													1			1		1
Ceratopogonidae																	3	1
Chaoboridae																		
Chironomidae	74	4	17	3	2		5	1	12	22	33	113	188	98	7	27	144	98
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae	3	2	1							1	9	18	23	1	6			
Psychodidae																		
Stratiomyidae													1					
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (2.4): Aquatic macroinvertebrates collected from stations 55 and 57 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3	57C1/3	57C2/3	57C3/3	57CH1/3	57CH2/3	57CH3/3	57L1/3	57 2/3	57L3/3	57E1/3	57E2/3	57E3/3
Dugesiidae																		
Oligochaeta	6	1	2	23	22	60		2				4			2	2	9	
Glossiphoniidae																		
Cambaridae	2	5	4				1	4	1	2	12	9	2	3	2	3	12	
Atyidae								1		1	5	2			1		20	
Trombidiformes																		
Baetidae	1				3	2	7	12	15	44	132	43		2	7	5		
Cloeon inscriptum			5														8	
Cloeon schoenemundi												53	21					
Caenis luctuosa				2	173	5	6	1	1	2	42	11	53	26	1	6	10	1
Coenagrionidae	7	1	3	1	1		8	3	4	4		1		4		2	17	3
***Ischnura* sp.**	1		2		1		2	1	1		2			1		4	2	1
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**																		
Aeshnidae							1								1			
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
***Anax* sp.**																		
Libellulidae														6				
Crocothemis erythraea																		
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi				16	142	6									1			
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera																		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (2.4): (Continued).

Code/Habitat/Replica	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3	57C1/3	57C2/3	57C3/3	57CH1/3	57CH2/3	57CH3/3	57L1/3	57 2/3	57L3/3	57E1/3	57E2/3	57E3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus						1					1							
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor													2					
Ceratopogonidae							12		1		5	3	108	243	6		2	4
Chaoboridae																		
Chironomidae	27	4	23	12	56	18	42	57	32	44	31	31	53	44	4	56	83	63
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae	1	3	2				1	5	1								15	
Psychodidae																		
Stratiomyidae																		
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (2.5): Aquatic macroinvertebrates collected from stations 58, 84 and 92 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	84L1/3	84L2/3	84L3/3	92E1/3	92E2/3	92E3/3
Dugesiidae												
Oligochaeta		4	1			1		8		37	77	69
Glossiphoniidae												
Cambaridae	9	9	3									
Atyidae												
Trombidiformes								2				
Baetidae	37	76	4	1		2				2	16	
Cloeon inscriptum												
Cloeon schoenemundi					3							
Caenis luctuosa												
Coenagrionidae	10	13	1				2			4	61	3
***Ischnura* sp.**	8	9	2		1					1	12	1
Erythromma lindenii												
Erythromma viridulum												
Lestidae												
Lestes dryas												
Lestes viridis												
***Sympecma* sp.**												
***Platycnemis* sp.**		2										
Aeshnidae	1										1	
Aeshna mixta												
Anax imperator											1	
Anax parthenope												
***Anax* sp.**												
Libellulidae												
Crocothemis erythraea												
Orthetrum cancellatum												
***Orthetrum* sp.**												
Selysiothemis nigra												
Sympetrum fonscolombei												
Trithemis annulata												
Corixidae												
Corixa affinis												
Corixa panzeri												
Heliocorisa vermiculata												
Hesperocorixa linnaei												
Micronecta scholtzi				3		1				6	11	104
Sigara lateralis												
Gerris argentatus												
Gerris lateralis												
***Gerris* sp.**												
Mesovelia vittigera												
Naucoris maculatus												
Nepa cinerea												
Anisops sardeus												
***Notonecta* sp.**												
Plea minutissima												
Microvelia pygmaea												
Dryops luridus							4					
***Dryops* sp.**							2					
Agabus nebulosus												
***Agabus* sp.**							14	4	2			
Hydroglyphus geminus												
Hydroglyphus signatellus												
Hydroporus nigrita								2				

Table (2.5): (Continued).

Code/Habitat/Replica	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	84L1/3	84L2/3	84L3/3	92E1/3	92E2/3	92E3/3
Hydroporus obsoletus									2			
Hydroporus pubescens							46	20	24			
Hydroporus sp.												
Hygrotus inaequalis												
Hygrotus sp.												
Laccophilus hyalinus												
Laccophilus minutus												
Laccophilus sp.							8					
Ilybius sp.												
Stictotarsus griseostriatus												
Rhantus suturalis											2	
Oreodytes sp.												
Hydrovatus cuspidatus												
Hydrovatus sp.								2				
Stictonectes lepidus												
Gyrinus sp.												
Haliplus lineatocollis							40	20	18			
Haliplus sp.												
Helophorus alternans												
Helophorus brevipalpis							948	88	24		1	
Helophorus aquaticus							2	2				
Helophorus flavipes		1					78				1	
Helophorus minutus							2					
Hydraena sp.												
Ochthebius sp.							2					
Anacaena globulus												
Berosus hispanicus												
Berosus sp.												
Coelostoma sp.												
Helochares lividus												
Helochares sp.												
Hydrobius fuscipes							8	2				
Laccobius sinuatus							2					
Laccobius sp.												
Hydroscapha sp.												
Noterus laevis												
Cyphon sp.												
Hydrocyphon sp.												
Orthotrichia angustella												
Limnephilidae												
Polycentropodidae												
Ecnomus deceptor						1						
Ceratopogonidae			26	6	3	1					4	2
Chaoboridae												
Chironomidae	69	85	34	60	90	35	42	6	22	81	2139	427
Culicidae								2				
Dixidae									4			
Dolichopodidae												
Empididae		1				1				1	2	
Limoniidae	15	3	11							6	5	1
Psychodidae											4	
Stratiomyidae							32	2	6			
Syrphidae												
Tabanidae									2			
Tipulidae												

Table (2.6): Aquatic macroinvertebrates collected from stations 93 and 104 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	93C1/3	93C2/3	93C3/3	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Dugesiidae															
Oligochaeta	2	3	33		4	10	19	19	41	3	6	11		2	6
Glossiphoniidae			1												
Cambaridae							6		2						
Atyidae															
Trombidiformes															
Baetidae	1								1		1				
Cloeon inscriptum															
Cloeon schoenemundi															
Caenis luctuosa	1														
Coenagrionidae	4	3	5				1				1	7			
Ischnura sp.	1		1							1		3			
Erythromma lindenii															
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
Sympecma sp.															
Platycnemis sp.			1												
Aeshnidae								1							
Aeshna mixta															
Anax imperator															
Anax parthenope															
Anax sp.															
Libellulidae															
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.															
Selysiothemis nigra															
Symptrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi											7			1	6
Sigara lateralis													1		
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.															
Agabus nebulosus															
Agabus sp.															
Hydroglyphus geminus															
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (2.6): (Continued).

Code/Habitat/Replica	93C1/3	93C2/3	93C3/3	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															
Helophorus alternans															
Helophorus brevipalpis								1				1			
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.															
Coelostoma sp.															
Helochares lividus															
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus								1							
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae															
Chaoboridae															
Chironomidae	196	84	633	9	2	44	57	133	70	243	122	328	71	272	42
Culicidae															
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae								1				2			
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (2.7): Aquatic macroinvertebrates collected from station 107 during February 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E 1/3	107E 2/3	107E 3/3
Dugesiidae									
Oligochaeta	1	1	22	2			3	24	74
Glossiphoniidae									
Cambaridae	1	1							1
Atyidae									
Trombidiformes									
Baetidae			1	3					2
Cloeon inscriptum									
Cloeon schoenemundi						1			
Caenis luctuosa	9	131	53	13	7	5		1	1
Coenagrionidae				8	7	18	20	5	17
***Ischnura* sp.**	1			1		2	11		4
Erythromma lindenii									
Erythromma viridulum									
Lestidae									
Lestes dryas									
Lestes viridis									
***Sympecma* sp.**									
***Platycnemis* sp.**	5			1			26	2	62
Aeshnidae									
Aeshna mixta									
Anax imperator									
Anax parthenope									
***Anax* sp.**									
Libellulidae									
Crocothemis erythraea									
Orthetrum cancellatum									
***Orthetrum* sp.**									
Selysiothemis nigra									
Sympetrum fonscolombei									
Trithemis annulata									
Corixidae									
Corixa affinis					1				
Corixa panzeri									
Heliocorisa vermiculata									
Hesperocorixa linnaei									
Micronecta scholtzi								1	
Sigara lateralis									
Gerris argentatus									
Gerris lateralis									
***Gerris* sp.**									
Mesovelia vittigera									
Naucoris maculatus									5
Nepa cinerea									
Anisops sardeus									
***Notonecta* sp.**									
Plea minutissima									
Microvelia pygmaea									
Dryops luridus									
***Dryops* sp.**									
Agabus nebulosus									
***Agabus* sp.**									
Hydroglyphus geminus									
Hydroglyphus signatellus									
Hydroporus nigrita									

Table (2.7): (Continued).

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E 1/3	107E 2/3	107E 3/3
Hydroporus obsoletus									
Hydroporus pubescens									
Hydroporus sp.									
Hygrotus inaequalis									
Hygrotus sp.									
Laccophilus hyalinus									
Laccophilus minutus									
Laccophilus sp.									
Ilybius sp.									
Stictotarsus griseostriatus									
Rhantus suturalis									
Oreodytes sp.									
Hydrovatus cuspidatus									
Hydrovatus sp.									
Stictonectes lepidus									
Gyrinus sp.									
Haliplus lineatocollis									
Haliplus sp.									
Helophorus alternans							1		
Helophorus brevipalpis									
Helophorus aquaticus									
Helophorus flavipes									
Helophorus minutus									
Hydraena sp.									
Ochthebius sp.									
Anacaena globulus									
Berosus hispanicus									
Berosus sp.									
Coelostoma sp.									
Helochares lividus									
Helochares sp.									
Hydrobius fuscipes									
Laccobius sinuatus									
Laccobius sp.									
Hydroscapha sp.									
Noterus laevis									
Cyphon sp.									
Hydrocyphon sp.									
Orthotrichia angustella									
Limnephilidae									
Polycentropodidae									
Ecnomus deceptor									
Ceratopogonidae									
Chaoboridae									
Chironomidae	52	359	87	65	133	176	171	76	347
Culicidae									
Dixidae									
Dolichopodidae									
Empididae									
Limoniidae							9		4
Psychodidae									
Stratiomyidae									
Syrphidae									
Tabanidae									
Tipulidae									

Table (3.1): Aquatic macroinvertebrates collected from stations 7, 8 and 13 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Dugesiidae															
Oligochaeta	18	3		11	4	1	7	5	2	1	10	22			
Glossiphoniidae															
Cambaridae								1			1				
Atyidae															
Trombidiformes							1								
Baetidae							3	7			2				
Cloeon inscriptum															
Cloeon schoenemundi												1			
Caenis luctuosa															
Coenagrionidae							2	56		1		2	10	1	4
Ischnura sp.					2		10	36	2	1	8	2	1		2
Erythromma lindenii															
Erythromma viridulum															
Lestidae								2							
Lestes dryas															
Lestes viridis															
Sympecma sp.								1	1						
Platycnemis sp.							1								
Aeshnidae				2			1	1					1		
Aeshna mixta															
Anax imperator															
Anax parthenope															
Anax sp.															
Libellulidae								3			1		1	5	2
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.														2	
Selysiothemis nigra															
Sympetrum fonscolombei															
Trithemis annulata															
Corixidae														2	
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi	2		8		1			1			3	2			
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera								2							
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.															
Agabus nebulosus													1		
Agabus sp.															
Hydroglyphus geminus														1	
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (3.1): (Continued).

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	8L1/3	8L2/3	8L3/3	13L1/3	13L2/3	13L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus								3							
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.													1	4	
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.														2	
Coelostoma sp.															
Helochares lividus															
Helochares sp.				11		3	2				2		1		
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.													1		
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.			1	3											
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae	1							2			1		6		
Chaoboridae												1			
Chironomidae	71		8	213	17	81	26	582	189	22	610	284	119	27	82
Culicidae															
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae				1				1							
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (3.2): Aquatic macroinvertebrates collected from stations 35 and 47 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3
Dugesiidae															
Oligochaeta	71	8	4	3	13	2	8								3
Glossiphoniidae	1			1					1						
Cambaridae															
Atyidae															
Trombidiformes	2	10	1	8	2	2			1						
Baetidae	8	3		2	1	3					1				
Cloeon inscriptum															
Cloeon schoenemundi			19												
Caenis luctuosa															
Coenagrionidae			1												
Ischnura sp.		1	1	2											
Erythromma lindenii	1														
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
Sympecma sp.															
Platycnemis sp.	4	1	3	1		1				1					
Aeshnidae															
Aeshna mixta															
Anax imperator															
Anax parthenope															
Anax sp.															
Libellulidae															
Crocothemis erythraea															
Orthetrum cancellatum															
Orthetrum sp.															
Selysiothemis nigra															
Sympetrum fonscolombei															
Trithemis annulata															
Corixidae							1								
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi	3	5	20	10	22		31	6	11	6	6	3			1
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
Gerris sp.															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
Notonecta sp.															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
Dryops sp.											1				
Agabus nebulosus															
Agabus sp.															
Hydroglyphus geminus															
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (3.2): (Continued).

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.			6							1		2			
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															
Helophorus alternans															
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.															
Coelostoma sp.															
Helochares lividus			1												
Helochares sp.		1	14		5	1				4		1			
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor															
Ceratopogonidae				1		1									
Chaoboridae															
Chironomidae	116	19	316	239	349	12	15	36	227	259	92	102	4	9	10
Culicidae															
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae															
Psychodidae															
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (3.3): Aquatic macroinvertebrates collected from stations 49, 51 and 55 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3
Dugesiidae																		
Oligochaeta	5	8	13		1			1	3	14		3				6	7	27
Glossiphoniidae																		
Cambaridae		1			1		2	1				1		1	2			
Atyidae			1			3	6			3	2							
Trombidiformes		3								3	3	1		1				
Baetidae		2	2		3	10	3			19		2	1		1			
Cloeon inscriptum																		
Cloeon schoenemundi											15							
Caenis luctuosa	2	5	7		2	14	4	1		55	52	15			1	2		
Coenagrionidae				1	5	4	55	8	1	21	5				9	1		
Ischnura sp.				1	6	13	7	4		8	15	4	1	2		1		1
Erythromma lindenii																		
Erythromma viridulum																1		
Lestidae		1		2	22	14					3							
Lestes dryas																		
Lestes viridis																		
Sympecma sp.																		
Platycnemis sp.						1	6			4	4	3						
Aeshnidae				1	2		3								1			
Aeshna mixta																		
Anax imperator																		
Anax parthenope									1									
Anax sp.																		
Libellulidae							1											
Crocothemis erythraea																		
Orthetrum cancellatum																		
Orthetrum sp.																		
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi	2	12	33	5	3	24	1	1		9	3			10		40	6	354
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis					1													
Gerris sp.					1													
Mesovelia vittigera																		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
Notonecta sp.																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
Dryops sp.																		
Agabus nebulosus																		
Agabus sp.																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (3.3): (Continued).

Code/Habitat/Replica	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3	51L1/3	51L2/3	51L3/3	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.						1			1									
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.								1										
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor																		
Ceratopogonidae							2	1		7								1
Chaoboridae																		
Chironomidae	9	5	12	4	73	83	193	48	3	517	319	12	68	15	59	165	25	165
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae				1	4		8	2										
Psychodidae			1															
Stratiomyidae								1										
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (3.4): Aquatic macroinvertebrates collected from stations 57 and 58 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	57C1/3	57C2/3	57C3/3	57CH1/3	57CH2/3	57CH3/3	57L1/3	57L2/3	57L3/3	57E1/3	57E2/3	57E3/3	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3
Dugesiidae																		
Oligochaeta		1								1	5		6		2			
Glossiphoniidae																		
Cambaridae				2	1	4								2				
Atyidae	13		1	8	2	3	3			3								
Trombidiformes																		
Baetidae	4	1		10	54	490	3			1		3	9	23	10			
Cloeon inscriptum					2													
Cloeon schoenemundi			11		17						6					7	2	
Caenis luctuosa	5	2	14	5	17	16	12	67	11	6	3	8				2	1	
Coenagrionidae	4		5							1	5	2	1	3				
***Ischnura* sp.**		3	7	2	1	5		1		2	8		4	1	2			
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**																		
Aeshnidae										1								
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
***Anax* sp.**																		
Libellulidae																		
Crocothemis erythraea																		
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi	4		4		18	1	11			1								
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera																		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (3.4): (Continued).

Code/Habitat/Replica	57C1/3	57C2/3	57C3/3	57CH1/3	57CH2/3	57CH3/3	57L1/3	57L2/3	57L3/3	57E1/3	57E2/3	57E3/3	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus														1				
Laccobius sp.								2										
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor							1				1							
Ceratopogonidae	2		33		1			277	25		3					1	7	
Chaoboridae																		
Chironomidae	71	5	209	5	39	66	6	5	5	5	63	22	169	64	10	32	93	14
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae			9										5	7				
Psychodidae																		
Stratiomyidae																		
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (3.5): Aquatic macroinvertebrates collected from stations 84, 92, 93 and 104 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	84L1/3	84L2/3	84L3/3	92E1/3	92E2/3	92E3/3	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Dugesiidae																		
Oligochaeta	56	192	150	12		2	9	115	17	5	6	29	3	4	2	11	9	4
Glossiphoniidae								2										
Cambaridae												1						
Atyidae																		
Trombidiformes																		
Baetidae																		
Cloeon inscriptum								4										
Cloeon schoenemundi																		
Caenis luctuosa																		
Coenagrionidae						1												
Ischnura sp.			2	2	1	10												
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae	8	62	20															
Lestes dryas	6	14	16															
Lestes viridis		8	6															
Sympecma sp.																		
Platycnemis sp.																		
Aeshnidae						3												
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
Anax sp.																		
Libellulidae																		
Crocothemis erythraea																		
Orthetrum cancellatum																		
Orthetrum sp.													1					
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae								2										
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi				2		1	19	78	7	3	6	12	8		4	39	40	14
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis				1														
Gerris sp.																		
Mesovelia vittigera						10												
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
Notonecta sp.	2																	
Plea minutissima																1		
Microvelia pygmaea																		
Dryops luridus		30																
Dryops sp.																		
Agabus nebulosus																		
Agabus sp.		16																
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (3.5): (Continued).

Code/Habitat/Replica	84L1/3	84L2/3	84L3/3	92E1/3	92E2/3	92E3/3	93L1/3	93L2/3	93L3/3	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3
Hydroporus obsoletus	2																	
Hydroporus pubescens	4	6																
Hydroporus sp.			2															
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus	2																	
Laccophilus sp.																1		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.								1										
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus			2															
Gyrinus sp.																		
Haliplus lineatocollis		2	12															
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis	2	18	4															
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus	4	2																
Helochares sp.		2		2		1			1	2	1	1						
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor																		
Ceratopogonidae		2																
Chaoboridae																		
Chironomidae	4	4	6	103	5	247	27	396	4	256	14	293	90	10	71	226	236	8
Culicidae		4																
Dixidae				2														
Dolichopodidae																		
Empididae																		
Limoniidae				1		5												
Psychodidae		2		2														
Stratiomyidae	10	6	2			1												
Syrphidae				3	1													
Tabanidae			2															
Tipulidae				4		1												

Table (3.6): Aquatic macroinvertebrates collected from stations 107 and 118 during May 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	118E1/3	118E2/3	118E3/3
Dugesiidae												
Oligochaeta	103	62	3		1	10	27	2	75	92	17	229
Glossiphoniidae												
Cambaridae							1	1	2			
Atyidae												
Trombidiformes										1		1
Baetidae												
Cloeon inscriptum										2		
Cloeon schoenemundi												
Caenis luctuosa					1				1			
Coenagrionidae					1		2			1		
Ischnura sp.				1	3	2	5	2	7		1	
Erythromma lindenii												
Erythromma viridulum												
Lestidae												
Lestes dryas												
Lestes viridis												
Sympecma sp.												
Platycnemis sp.		1	1		4	4	18	1	19			
Aeshnidae							2		3			1
Aeshna mixta												
Anax imperator												
Anax parthenope												
Anax sp.												
Libellulidae										1		2
Crocothemis erythraea												
Orthetrum cancellatum												
Orthetrum sp.												
Selysiothemis nigra												
Symptrum fonscolombei												
Trithemis annulata												
Corixidae	2	2		1						23	2	8
Corixa affinis												
Corixa panzeri												
Heliocorisa vermiculata												
Hesperocorixa linnaei												
Micronecta scholtzi	7	2	1	1	3	1	7		13			
Sigara lateralis												
Gerris argentatus												
Gerris lateralis												
Gerris sp.												
Mesovelia vittigera												
Naucoris maculatus				2	4	9			9			
Nepa cinerea					1		2					1
Anisops sardeus												
Notonecta sp.												
Plea minutissima									1			
Microvelia pygmaea												
Dryops luridus												
Dryops sp.												
Agabus nebulosus												
Agabus sp.										1		1
Hydroglyphus geminus												
Hydroglyphus signatellus												
Hydroporus nigrita												

Table (3.6): (Continued).

Code/Habitat/Replica	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	118E1/3	118E2/3	118E3/3
Hydroporus obsoletus												
Hydroporus pubescens												
Hydroporus sp.												
Hygrotus inaequalis												
Hygrotus sp.										2		
Laccophilus hyalinus												1
Laccophilus minutus							4					
Laccophilus sp.					19	15	1			8		8
Ilybius sp.	1			5			3		50	12	1	6
Stictotarsus griseostriatus												
Rhantus suturalis												
Oreodytes sp.												
Hydrovatus cuspidatus										2		
Hydrovatus sp.												2
Stictonectes lepidus												
Gyrinus sp.												
Haliplus lineatocollis												
Haliplus sp.												
Helophorus alternans							1			2		
Helophorus brevipalpis										1		
Helophorus aquaticus												
Helophorus flavipes												
Helophorus minutus												
Hydraena sp.												
Ochthebius sp.										1		
Anacaena globulus										1		
Berosus hispanicus												
Berosus sp.												
Coelostoma sp.												
Helochares lividus					2	2	2			1		
Helochares sp.						1	23			8	1	4
Hydrobius fuscipes												
Laccobius sinuatus												
Laccobius sp.												
Hydroscapha sp.												
Noterus laevis										2		2
Cyphon sp.									1			
Hydrocyphon sp.												
Orthotrichia angustella												
Limnephilidae												
Polycentropodidae												
Ecnomus deceptor												
Ceratopogonidae										5		
Chaoboridae												
Chironomidae	140	161	4	13	409	515	493	5	563	142	5	261
Culicidae										1		
Dixidae												
Dolichopodidae												
Empididae												
Limoniidae					1		4	1	16			
Psychodidae							2			21		13
Stratiomyidae												
Syrphidae												
Tabanidae												
Tipulidae									1	1		

Table (4.1): Aquatic macroinvertebrates collected from stations 7, 8 and 35 during July 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3
Dugesiidae																		
Oligochaeta		4		2			1		1	5			4	12	8		7	5
Glossiphoniidae										21	17	7	6	7	1		8	
Cambaridae								1	1									
Atyidae																		
Trombidiformes									3	11	56	4	3	5	2		4	
Baetidae				1				8	12	2	1		4	4	7			
Cloeon inscriptum													3					
Cloeon schoenemundi																		
Caenis luctuosa								1			6	5	4	2	9	1	7	4
Coenagrionidae			3		2	4	54	97	54	1	5	1	30	5	19	11	7	1
***Ischnura* sp.**			1	1	2		11	25	2	3	1	2	6	4	11	2		
Erythromma lindenii													3			5	1	
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**															3			
Aeshnidae							1	1				2	3	5	12			
Aeshna mixta									1									
Anax imperator																		
Anax parthenope																		
***Anax* sp.**														1				
Libellulidae																		1
Crocothemis erythraea																		
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi		9						1	1	57	47	11	92	27	114	84	61	27
Sigara lateralis																		
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera								1							1			
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (4.1): (Continued).

Code/Habitat/Replica	7L1/3	7L2/3	7L3/3	7E1/3	7E2/3	7E3/3	8E1/3	8E2/3	8E3/3	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.								3			7		1	1				
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus							1	8	2						1			
Hydrovatus sp.							2		3						1			
Stictonectes lepidus																		
Gyrinus sp.										1								
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans							1											
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus														1				
Berosus hispanicus																		
Berosus sp.									1									
Coelostoma sp.																		
Helochares lividus												1						
Helochares sp.		1						1			1							
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis							1		1					4	1			
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor																		
Ceratopogonidae																		
Chaoboridae										1								
Chironomidae	18	41	28	225	182	683	47	6	29	211	177	10	362	96	226	107	51	30
Culicidae																		
Dixidae					1													
Dolichopodidae																		
Empididae																		
Limoniidae				6	9	7	4	8	1		4		2	4	23			
Psychodidae																		
Stratiomyidae				1			3											
Syrphidae															1			
Tabanidae																		
Tipulidae																		

Table (4.2): Aquatic macroinvertebrates collected from stations 47, 49 and 51 during July 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3
Dugesiidae															
Oligochaeta								2	1		2	1	1	4	
Glossiphoniidae															
Cambaridae											1		34	1	
Atyidae										3				36	
Trombidiformes												1	2		
Baetidae												3	1		
Cloeon inscriptum															
Cloeon schoenemundi															1
Caenis luctuosa							38	11	15	2	1	5	3	19	20
Coenagrionidae		1	1				3	2	1	32	4	20	13	44	27
***Ischnura* sp.**		2	1							4		3		14	6
Erythromma lindenii			1												
Erythromma viridulum															
Lestidae															
Lestes dryas															
Lestes viridis															
***Sympecma* sp.**															
***Platycnemis* sp.**													1		
Aeshnidae												2		1	2
Aeshna mixta															
Anax imperator															
Anax parthenope															
***Anax* sp.**															
Libellulidae															
Crocothemis erythraea															
Orthetrum cancellatum															
***Orthetrum* sp.**															
Selysiothemis nigra															
Sympetrum fonscolombei															
Trithemis annulata															
Corixidae															
Corixa affinis															
Corixa panzeri															
Heliocorisa vermiculata															
Hesperocorixa linnaei															
Micronecta scholtzi	2	7	9	18	2	43		4	1	5	3	1	2	4	8
Sigara lateralis															
Gerris argentatus															
Gerris lateralis															
***Gerris* sp.**															
Mesovelia vittigera															
Naucoris maculatus															
Nepa cinerea															
Anisops sardeus															
***Notonecta* sp.**															
Plea minutissima															
Microvelia pygmaea															
Dryops luridus															
***Dryops* sp.**															
Agabus nebulosus															
***Agabus* sp.**															
Hydroglyphus geminus															
Hydroglyphus signatellus															
Hydroporus nigrita															

Table (4.2): (Continued).

Code/Habitat/Replica	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3	49L1/3	49L2/3	49L3/3	49E1/3	49E2/3	49E3/3	51E1/3	51E2/3	51E3/3
Hydroporus obsoletus															
Hydroporus pubescens															
Hydroporus sp.															
Hygrotus inaequalis															
Hygrotus sp.															
Laccophilus hyalinus															
Laccophilus minutus															
Laccophilus sp.															
Ilybius sp.															
Stictotarsus griseostriatus															
Rhantus suturalis															
Oreodytes sp.															
Hydrovatus cuspidatus															
Hydrovatus sp.															
Stictonectes lepidus															
Gyrinus sp.															
Haliplus lineatocollis															
Haliplus sp.															
Helophorus alternans										1					
Helophorus brevipalpis															
Helophorus aquaticus															
Helophorus flavipes															
Helophorus minutus															
Hydraena sp.															
Ochthebius sp.															
Anacaena globulus															
Berosus hispanicus															
Berosus sp.															
Coelostoma sp.						1									
Helochares lividus															1
Helochares sp.															
Hydrobius fuscipes															
Laccobius sinuatus															
Laccobius sp.															
Hydroscapha sp.															
Noterus laevis															
Cyphon sp.															
Hydrocyphon sp.															
Orthotrichia angustella															
Limnephilidae															
Polycentropodidae															
Ecnomus deceptor							4	1	1					3	4
Ceratopogonidae		1								1					1
Chaoboridae															
Chironomidae	33	8	139	5	3	11	24	26	3	177	13	101	8	72	135
Culicidae															
Dixidae															
Dolichopodidae															
Empididae															
Limoniidae	1									11	3	14	3	23	15
Psychodidae										1				2	
Stratiomyidae															
Syrphidae															
Tabanidae															
Tipulidae															

Table (4.3): Aquatic macroinvertebrates collected from stations 55 and 57 during July 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3	57C1/3	57C2/3	57C3/3	57L1/3	57L2/3	57L3/3	57CH1/3	57CH2/3	57CH3/3	57E1/3	57E2/3	57E3/3
Dugesiidae																		
Oligochaeta		2		15	4						1					5	3	
Glossiphoniidae																		
Cambaridae											1							
Atyidae							1	3					65	3	6			
Trombidiformes																		
Baetidae	1													46	12	1	1	
Cloeon inscriptum									4									
Cloeon schoenemundi									2				9					
Caenis luctuosa				4	2	1		3	14				167	98	14	1	5	
Coenagrionidae	5	14	14	3		1	11	26	7	1		1	8	14	3	31	22	11
Ischnura sp.			2					1	3					2			1	1
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
Sympecma sp.																		
Platycnemis sp.																		
Aeshnidae		1						1	1				1			1		
Aeshna mixta																		
Anax imperator																		
Anax parthenope																		
Anax sp.																		
Libellulidae	1												8	2				
Crocothemis erythraea																		
Orthetrum cancellatum																		
Orthetrum sp.																		
Selysiothemis nigra																		
Symptrum fonscolombei																		
Trithemis annulata																		
Corixidae																		
Corixa affinis																		
Corixa panzeri																		
Heliocorisa vermiculata																		
Hesperocorixa linnaei																		
Micronecta scholtzi	4	6	1		1	2	2	3		7			1	2	25	4	3	1
Sigara lateralis																		
Gerris argentatus																		1
Gerris lateralis																		
Gerris sp.																		2
Mesovelia vittigera																4		
Naucoris maculatus																		
Nepa cinerea																		
Anisops sardeus																		
Notonecta sp.																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
Dryops sp.																		
Agabus nebulosus																		
Agabus sp.																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (4.3): (Continued).

Code/Habitat/Replica	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3	57C1/3	57C2/3	57C3/3	57L1/3	57L2/3	57L3/3	57CH1/3	57CH2/3	57CH3/3	57E1/3	57E2/3	57E3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.																		
Ilybius sp.																		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus																		
Helochares sp.																		
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.																		
Hydroscapha sp.																		
Noterus laevis																		
Cyphon sp.																		
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor											1					4		
Ceratopogonidae						1			2				2			1		1
Chaoboridae																		
Chironomidae	30	4	11	15	16	34	4	12	16	5	4		51	55	32	30	59	6
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae		1	2				2	3	1								1	
Psychodidae																		
Stratiomyidae																		
Syrphidae																		
Tabanidae																		
Tipulidae																		

Table (4.4): Aquatic macroinvertebrates collected from stations 58, 92 and 93 during July 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	92E1/3	92E2/3	92E3/3	93L1/3	93L2/3	93L3/3
Dugesiidae												
Oligochaeta		4				1	10		18	2	3	
Glossiphoniidae												
Cambaridae												
Atyidae												
Trombidiformes		1			1							
Baetidae	1	1	1				1		2	3		
Cloeon inscriptum										6		
Cloeon schoenemundi												
Caenis luctuosa	3	8	30		6	5			1	14	7	2
Coenagrionidae	10	9	32		1	1	10	15	10	14		
***Ischnura* sp.**	1	4					4		1			
Erythromma lindenii												
Erythromma viridulum												
Lestidae												
Lestes dryas												
Lestes viridis												
***Sympecma* sp.**												
***Platycnemis* sp.**												
Aeshnidae		4					1	5		1	1	
Aeshna mixta												
Anax imperator												
Anax parthenope												
***Anax* sp.**												
Libellulidae												
Crocothemis erythraea												
Orthetrum cancellatum												
***Orthetrum* sp.**			1									
Selysiothemis nigra												
Symptrum fonscolombei												
Trithemis annulata			1									
Corixidae												
Corixa affinis												
Corixa panzeri												
Heliocorisa vermiculata												
Hesperocorixa linnaei												
Micronecta scholtzi					1	1		1	10	39	16	6
Sigara lateralis												
Gerris argentatus												
Gerris lateralis												
***Gerris* sp.**								1				
Mesovelia vittigera			1				3	3				
Naucoris maculatus												
Nepa cinerea												
Anisops sardeus												
***Notonecta* sp.**												
Plea minutissima												
Microvelia pygmaea								1				
Dryops luridus												
***Dryops* sp.**												
Agabus nebulosus												
***Agabus* sp.**												
Hydroglyphus geminus												
Hydroglyphus signatellus												
Hydroporus nigrita												

Table (4.4): (Continued).

Code/Habitat/Replica	58C1/3	58C2/3	58C3/3	58L1/3	58L2/3	58L3/3	92E1/3	92E2/3	92E3/3	93L1/3	93L2/3	93L3/3
Hydroporus obsoletus												
Hydroporus pubescens												
Hydroporus sp.												
Hygrotus inaequalis												
Hygrotus sp.												
Laccophilus hyalinus												
Laccophilus minutus												
Laccophilus sp.												
Ilybius sp.												
Stictotarsus griseostriatus												
Rhantus suturalis												
Oreodytes sp.												
Hydrovatus cuspidatus												
Hydrovatus sp.												
Stictonectes lepidus												
Gyrinus sp.												
Haliplus lineatocollis												
Haliplus sp.												
Helophorus alternans												
Helophorus brevipalpis												
Helophorus aquaticus												
Helophorus flavipes												
Helophorus minutus												
Hydraena sp.												
Ochthebius sp.												
Anacaena globulus												
Berosus hispanicus												
Berosus sp.												
Coelostoma sp.												
Helochares lividus												
Helochares sp.							6	2	2	1		
Hydrobius fuscipes												
Laccobius sinuatus												
Laccobius sp.												
Hydroscapha sp.												
Noterus laevis												
Cyphon sp.												
Hydrocyphon sp.												
Orthotrichia angustella												
Limnephilidae												
Polycentropodidae												
Ecnomus deceptor												
Ceratopogonidae		2	2		3							
Chaoboridae												
Chironomidae	68	65	188	4	26	11	99	20	29	64	16	4
Culicidae												
Dixidae												
Dolichopodidae												
Empididae												
Limoniidae			3				2	4	2			
Psychodidae												
Stratiomyidae							1		1			
Syrphidae												
Tabanidae					1							
Tipulidae												

Table (4.5): Aquatic macroinvertebrates collected from stations 104 and 107 during July 1999. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Code/Habitat/Replica	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3
Dugesiidae																		
Oligochaeta			13	1	1			8	10	3	110	35	33	1	1		3	29
Glossiphoniidae																		
Cambaridae														1			1	
Atyidae																		
Trombidiformes																		
Baetidae	3								1	2	1		7	3	1	3	3	6
Cloeon inscriptum	5	6	1															
Cloeon schoenemundi																		
Caenis luctuosa										1	1	1	1			3	2	1
Coenagrionidae	1	1				1			1			1	4	9			38	45
***Ischnura* sp.**	1	1		1		1					2		8		2	11	5	26
Erythromma lindenii																		
Erythromma viridulum																		
Lestidae																		
Lestes dryas																		
Lestes viridis																		
***Sympecma* sp.**																		
***Platycnemis* sp.**											1							3
Aeshnidae	3	2	2		2	1				2	2		1	1	2	3	2	6
Aeshna mixta																		
Anax imperator																		
Anax parthenope																	1	
***Anax* sp.**																		1
Libellulidae																		
Crocothemis erythraea																		1
Orthetrum cancellatum																		
***Orthetrum* sp.**																		
Selysiothemis nigra																		
Symptrum fonscolombei											1				1			
Trithemis annulata																		
Corixidae										3	2							
Corixa affinis																		
Corixa panzeri																1		
Heliocorisa vermiculata											1							
Hesperocorixa linnaei																		
Micronecta scholtzi	75	101	17	4	1	1	464	610	16	915	1311	1209	51	42	4	17	42	30
Sigara lateralis							1											
Gerris argentatus																		
Gerris lateralis																		
***Gerris* sp.**																		
Mesovelia vittigera	3	3																
Naucoris maculatus		3				1				1			50	14	11	7	14	13
Nepa cinerea																		2
Anisops sardeus																1		
***Notonecta* sp.**																		
Plea minutissima																		
Microvelia pygmaea																		
Dryops luridus																		
***Dryops* sp.**																		
Agabus nebulosus																		
***Agabus* sp.**																		
Hydroglyphus geminus																		
Hydroglyphus signatellus																		
Hydroporus nigrita																		

Table (4.5): (Continued).

Code/Habitat/Replica	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3	107L1/3	107L2/3	107L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3
Hydroporus obsoletus																		
Hydroporus pubescens																		
Hydroporus sp.																		
Hygrotus inaequalis																		
Hygrotus sp.																		
Laccophilus hyalinus																		
Laccophilus minutus																		
Laccophilus sp.											1			1			1	8
Ilybius sp.																4		
Stictotarsus griseostriatus																		
Rhantus suturalis																		
Oreodytes sp.																		
Hydrovatus cuspidatus																		
Hydrovatus sp.																		
Stictonectes lepidus																		
Gyrinus sp.																		
Haliplus lineatocollis																		
Haliplus sp.																		
Helophorus alternans																		
Helophorus brevipalpis																		
Helophorus aquaticus																		
Helophorus flavipes																		
Helophorus minutus																		
Hydraena sp.																		
Ochthebius sp.																		
Anacaena globulus																		
Berosus hispanicus																		
Berosus sp.																		
Coelostoma sp.																		
Helochares lividus													1	3		1	2	2
Helochares sp.	8	6	1		2	1					3		16	13	1	5	10	36
Hydrobius fuscipes																		
Laccobius sinuatus																		
Laccobius sp.							1											
Hydroscapha sp.																		
Noterus laevis																1		1
Cyphon sp.																		1
Hydrocyphon sp.																		
Orthotrichia angustella																		
Limnephilidae																		
Polycentropodidae																		
Ecnomus deceptor																		
Ceratopogonidae																		
Chaoboridae																		
Chironomidae	66	45	3	3	9	4	19	73	60	1816	1390	1148	205	115	22	34	58	845
Culicidae																		
Dixidae																		
Dolichopodidae																		
Empididae																		
Limoniidae	2	2			2								5	2	4		13	8
Psychodidae																		2
Stratiomyidae																		1
Syrphidae																		
Tabanidae	1																	
Tipulidae																		

Table (5): Aquatic macroinvertebrates collected from stations 8, 13, 35 and 49 during October 2009. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and the number of replica.

Taxon	8E1/3	8E2/3	8E3/3	13L1/3	35C1/3	35C2/3	35C3/3	35E1/3	35E 2/3	35E 3/3	35L 1/3	35L 2/3	35L 3/3	49L1/3	49L2/3	49L 3/3
Dugesiidae																
Oligochaeta	10	15			5	7	8	14	45	10			9			
Glossiphoniidae							2	2	4	1	3	16	5			
Cambaridae		2	5			1			1					2		8
Atyidae																
Trombidiformes																
Baetidae										1				1		1
Cloeon inscriptum																
Cloeon schoenemundi																
Caenis luctuosa											1					
Coenagrionidae		3	3	4	7		7	4	23	8			2	4		9
Ischnura sp.																
Erythromma lindenii																
Erythromma viridulum																
Lestidae																
Lestes dryas																
Lestes viridis																
Sympecma sp.																
Platycnemis sp.	4	7	1		3				3							
Aeshnidae						3										
Aeshna mixta																
Anax imperator																
Anax parthenope																
Anax sp.																
Libellulidae									2							
Crocothemis erythraea																
Orthetrum cancellatum									1							
Orthetrum sp.																
Selysiothemis nigra																
Symptrum fonscolombei																
Trithemis annulata																
Corixidae				1												
Corixa affinis																
Corixa panzeri																
Heliocorisa vermiculata																
Hesperocorixa linnaei																
Micronecta scholtzi	1				7	10	61	1	13	3			9	10	3	
Sigara lateralis																
Sigara selecta				1												
Gerris argentatus																
Gerris lateralis																
Gerris sp.																
Mesovelia vittigera																
Naucoris maculatus																
Nepa cinerea																
Anisops sardeus																
Notonecta sp.																
Plea minutissima																
Microvelia pygmaea																
Dryops luridus																
Dryops sp.																
Agabus nebulosus																
Agabus sp.																
Hydroglyphus geminus																
Hydroglyphus signatellus				2												

Table (5): (Continued).

Code/Habitat/Replica	8E1/3	8E2/3	8E3/3	13L1/3	35C1/3	35C2/3	35C3/3	35E1/3	35E 2/3	35E 3/3	35L 1/3	35L 2/3	35L 3/3	49L1/3	49L2/3	49L 3/3
Hydroporus nigrita																
Hydroporus obsoletus																
Hydroporus pubescens																
Hydroporus sp.																
Hygrotus inaequalis																
Hygrotus sp.																
Laccophilus hyalinus																
Laccophilus minutus																
Laccophilus sp.																
Ilybius sp.																
Stictotarsus griseostriatus																
Rhantus suturalis																
Oreodytes sp.																
Hydrovatus cuspidatus																
Hydrovatus sp.																
Stictonectes lepidus																
Gyrinus sp.																
Haliplus lineatocollis																
Haliplus sp.																
Helophorus alternans																
Helophorus brevipalpis																
Helophorus aquaticus																
Helophorus flavipes																
Helophorus minutus																
Hydraena sp.																
Ochthebius sp.																
Anacaena globulus																
Berosus hispanicus				1												
Berosus sp.																
Coelostoma sp.																
Helochares lividus																
Helochares sp.																
Hydrobius fuscipes																
Laccobius sinuatus																
Laccobius sp.																
Hydroscapha sp.																
Noterus laevis									1	1						
Cyphon sp.																
Hydrocyphon sp.																
Orthotrichia angustella																
Limnephilidae																
Polycentropodidae																
Ecnomus deceptor																
Ceratopogonidae				110										6		1
Chaoboridae																
Chironomidae	119	103	12		57	97	159	100	402	57	10	19	16	10		1
Culicidae																
Dixidae																
Dolichopodidae																
Empididae																
Limoniidae		3	5				1	3	30	6				1		
Psychodidae																
Stratiomyidae																
Syrphidae																
Tabanidae																
Tipulidae																

Table (6.1): Aquatic Odonata (larvae) collected from stations 7, 8, 13 and 34 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	7E1/3	7E2/3	7L1/3	8E1/3	8E2/3	8E3/3	13L2/3	13L (Center)	13L (Bank)	34C1/3	34C2/3	34C3/3	34E1/3	34E2/3	34E3/3	34L1/3	34L2/3	34L3/3
Coenagrionidae	1	1		15	8	13	36	12	12	39	56	8	27	14	72		6	13
Ischnura sp.	2		1	10	4	7	9	2	3	8		2	1		7			
Aeshnidae				1		1	2	1	1		2		4		9			
Libellulidae							28	37	35								1	4
Sympecma fusca							1											
Platycnemis sp.																1		
Gomphidae																		1
Erythromma lindenii										1	2				1			
Anax sp.																		
Anax imperator																		
Orthetrum cancellatum																		
Sympetrum fonscolombei							20	10	10									

Table (6.2): Aquatic Odonata (larvae) collected from stations 35, 47 and 49 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L2/3	49C1/3	49C2/3	49C3/3	49E1/3	49E2/3	49E3/3	49L1/3	49L2/3	49L3/3
Coenagrionidae	5	7	3	4	16	16	2	7	12	1	1			26	7	19	22	36	61	3	32	10
Ischnura sp.	2	4	2	2	5	3			3	1				1		1	1					
Aeshnidae			1	1	2					1	2	2	1			1	5	1	7			1
Libellulidae	1						7										1		7		10	11
Sympecma fusca																						
Platycnemis sp.																						
Gomphidae																						
Erythromma lindenii			1	5					4													
Anax sp.																						
Anax imperator																						
Orthetrum cancellatum																						
Sympetrum fonscolombei																						

Table (6.3): Aquatic Odonata (larvae) collected from stations 51, 55 and 57 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	51C+E1/3	51C+E2/3	51C+E3/3	51L1/3	51L2/3	51L3/3	55C1/3	55C2/3	55C3/3	55L1/3	55L2/3	55L3/3	57C1/3	57C2/3	57C3/3	57E1/3	57E2/3	57E3/3	57L1/3	57L2/3
Coenagrionidae	43	127	80	406	292	147	16	20	77	5	2	2	1	4	8	49	12	29	2	4
Ischnura sp.	2		6	1	4	1	3		6		1			1	1	3		1		
Aeshnidae	2			4	2	1	1	4	8	1	1	1				1				
Libellulidae		1	1	5			1	23	15			4								
Sympecma fusca																				
Platycnemis sp.																				
Gomphidae																				
Erythromma lindenii																				
Anax sp.																				
Anax imperator		1																		
Orthetrum cancellatum																				
Sympetrum fonscolombei																				

Table (6.4): Aquatic Odonata (larvae) collected from stations 58, 85, 92 and 93 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	58C1/3	58C2/3	58C3/3	58L2/3	58L3/3	85E1/3	85E2/3	85E3/3	85L1/3	85L3/3	92E1/3	92E2/3	92E3/3	93C1/3	93C2/3	93C3/3	93L1/3
Coenagrionidae	25	14	35	5	1	7	2	3	5	3	39	7	13	5	17	61	
Ischnura sp.	1	1	1			3	1		1	1	10	1		1	3	12	1
Aeshnidae		1	2								2		1		1	2	
Libellulidae	2			1		1	1										
Sympecma fusca																	
Platycnemis sp.																	
Gomphidae																	
Erythromma lindenii																	
Anax sp.											1						
Anax imperator																	
Orthetrum cancellatum																	
Sympetrum fonscolombei																	

Table (6.5): Aquatic Odonata (larvae) collected from stations 104, 107 and 118 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	107L1/3	107L2/3	107L3/3	118L1/3	118L2/3	118L3/3
Coenagrionidae	3	4	10	8	5	62	4	1	1	23	7	31	281	225	67	3	6	7	3	3	2
***Ischnura* sp.**	1	1	4		4	1				9	5	7	20	17	6		1		2	1	2
Aeshnidae		2		8		4			3	1		3	8	6	2	3					
Libellulidae				1		1	3				1		1								
Sympecma fusca																					
***Platycnemis* sp.**														1							
Gomphidae																					
Erythromma lindenii																					
***Anax* sp.**																					
Anax imperator																					
Orthetrum cancellatum																	1				
Sympetrum fonscolombei																					

Table (7): Aquatic Odonata (exuviae) collected from the study stations of the Southeast Regional Park during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	8E1/3	8E3/3	13L1/3	13L2/3	34C1/3	34C2/3	34C3/3	34E2/3	49C3/3	55C3/3	57C3/3	57E3/3	93C2/3
Aeshnidae	2	1			1		1	2	1	1			
Erythromma lindenii							1						
***Ischnura* sp.**											1	1	2
Sympetrum fonscolombei			1	1									
Anax* cf. *imperator						1							

Table (8.1): Adults of Odonata collected and observed in stations 7, 8, 13, 28, 30 and 34 during 1998, 1999 and 2000.

Station	7			8			13		28	30	34
Date	02/06/1999	28/07/1999	08/06/2000	02/06/1999	28/07/1999	08/06/2000	28/07/1999	08/06/2000	02/06/1999	07/06/2000	07/06/2000
Sympecma fusca				1							
Platycnemis latipes	1		2		3	4			4		14
Erythromma lindenii											
Coenagrion puella											
Enallagma cyathigerum								9		1	2
Erythromma viridulum											
Ischnura elegans		1	1	1		1				1	2
Ischnura graellsii			1	6			4	7	2	1	2
Ischnura pumilio				1				1			1
Anax imperator										Present	
Anax parthenope										Present	Present
Crocothemis erythraea					Present						
Orthetrum cancellatum						Present		1		Present	1
Sympetrum fonscolombei							1				1
Brachythemis leucosticta											
Sympetrum vulgatum								2		1	
Trithemis annulata										1	

Table (8.2): Adults of Odonata collected and observed in stations 35, 45, 47, 49 and 51 during 1998, 1999 and 2000.

Station	35				45	47		49			51	
Date	01/06/1999	28/07/1999	07/10/1999	31/05/2000	02/06/1999	28/07/1999	07/06/2000	01/06/1999	27/07/1999	07/06/2000	27/07/1999	07/06/2000
Sympecma fusca												
Platycnemis latipes	3	3		5	5		2					1
Erythromma lindenii				1								
Coenagrion puella												
Enallagma cyathigerum			2	3			1					
Erythromma viridulum												
Ischnura elegans				1	6			2	1	4	2	9
Ischnura graellsii	5	5		3	1							
Ischnura pumilio										1		
Anax imperator									Present			
Anax parthenope									Present	Present		
Crocothemis erythraea												
Orthetrum cancellatum												
Sympetrum fonscolombei											1	
Brachythemis leucosticta						1						
Sympetrum vulgatum												1
Trithemis annulata				1					2			

Table (8.3): Adults of Odonata collected and observed in stations 55, 56, 57 and 58 during 1998, 1999 and 2000.

Station	55				56		57				58	
Date	21/05/1999	01/06/1999	28/07/1999	31/05/2000	01/06/1999	28/07/1999	21/10/1998	01/06/1999	28/07/1999	07/06/2000	27/07/1999	31/05/2000
Sympecma fusca												
Platycnemis latipes									3			
Erythromma lindenii												
Coenagrion puella												
Enallagma cyathigerum												1
Erythromma viridulum												
Ischnura elegans			2	4			1	3	3	8	2	3
Ischnura graellsii												
Ischnura pumilio												
Anax imperator												
Anax parthenope		Present		Present	Present	Present			Present	Present		Present
Crocothemis erythraea		Present								1		
Orthetrum cancellatum		1		Present						Present		Present
Sympetrum fonscolombei												
Brachythemis leucosticta												
Sympetrum vulgatum												
Trithemis annulata										1		

Table (8.4): Adults of Odonata collected and observed in stations 83, 85, 91, 92, 93, 104, 107 and 118 during 1998, 1999 and 2000.

Station	83	85	91	92			93		104			107		118
Date	31/05/2000	30/05/2000	01/06/1999	01/06/1999	27/07/1999	30/05/2000	27/07/1999	30/05/2000	29/07/1998	27/07/1999	30/05/2000	27/07/1999	30/05/2000	31/05/2000
Sympecma fusca														
Platycnemis latipes		1					4	Present		2	1	2	3	
Erythromma lindenii														
Coenagrion puella														3
Enallagma cyathigerum							2	1			1	1	3	
Erythromma viridulum										2				
Ischnura elegans		5						1				7	13	
Ischnura graellsii	1		2	3	2	3	2				1	1	8	
Ischnura pumilio					1	1						2		
Anax imperator							Present						Present	
Anax parthenope	Present						Present	Present			Present		Present	
Crocothemis erythraea														
Orthetrum cancellatum	Present						1				1		Present	
Sympetrum fonscolombei										Present				
Brachythemis leucosticta														
Sympetrum vulgatum								1				1	1	
Trithemis annulata	Present													

Table (9.1): Aquatic Heteroptera collected from stations 7, 8, 13 and 34 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	7E 1/3	7E2/3	7E3/3	7L2/3	7L3/3	8E1/3	8E3/3	13(Center)	13L2/3	13(Bank)	34C2/3	34E1/3	34E3/3	34L1/3	34L2/3	34L3/3
Anisops sardeus																
Anisops sp.	2	2														
Corixa affinis								1								
Corixinae										1						
Cymatia rogenhoferi								2								
Gerris argentatus	1															
Gerris asper																
Gerris gibbifer																
Gerris sp.																
Gerris thoracicus																
Hesperocorixa linnaei																
Mesovelia vittigera	19	23	13			4	1				4	1	4			
Micronecta scholtzi	1		2	3	2							1				
Micronecta sp.			1	6	4	1	17			1	1	1		Present	Present	Present
Microvelia pygmaea																
Naucoris maculatus																
Nepa cinerea																
Notonecta maculata																
Notonecta sp.					1											
Notonecta viridis viridis									2							
Sigara lateralis		3			2											

Table (9.2): Aquatic Heteroptera collected from stations 35 and 47 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	35C1/3	35C2/3	35C3/3	35E1/3	35E2/3	35E3/3	35L1/3	35L2/3	35L3/3	47E1/3	47E2/3	47E3/3	47L1/3	47L2/3	47L3/3
Anisops sardeus															
Anisops sp.					1										
Corixa affinis															
Corixinae															
Cymatia rogenhoferi															
Gerris argentatus															
Gerris asper															
Gerris gibbifer															
Gerris sp.															
Gerris thoracicus															
Hesperocorixa linnaei															
Mesovelia vittigera					13										
Micronecta scholtzi	3	Present	Present	7	7	5			Present	2					
Micronecta sp.	16	Present	Present	58	8	90	Present	26	Present	55	161	48	Present	104	24
Microvelia pygmaea															
Naucoris maculatus															
Nepa cinerea															
Notonecta maculata															
Notonecta sp.															
Notonecta viridis viridis															
Sigara lateralis															

Table (9.3): Aquatic Heteroptera collected from stations 49, 51, 55 and 58 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	**49C1/3**	**49E2/3**	**49E3/3**	**49L1/3**	**49L2/3**	**49L3/3**	**51C+E1/3**	**51L1/3**	**51L2/3**	**55C1/3**	**55C2/3**	**55C3/3**	**55L2/3**	**55L3/3**	**58L2/3**
Anisops sardeus															
***Anisops* sp.**															
Corixa affinis															
Corixinae															
Cymatia rogenhoferi															
Gerris argentatus		1													
Gerris asper															
Gerris gibbifer															
***Gerris* sp.**															
Gerris thoracicus															
Hesperocorixa linnaei															
Mesovelia vittigera		1													
Micronecta scholtzi		2	Present	1				Present				9	6	1	
***Micronecta* sp.**	1			1		Present		1	Present	1	1	2	2	Present	Present
Microvelia pygmaea															
Naucoris maculatus															
Nepa cinerea															
Notonecta maculata															
***Notonecta* sp.**															
Notonecta viridis viridis															
Sigara lateralis															

Table (9.4): Aquatic Heteroptera collected from stations 84, 85, 92 and 93 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	84L1/3	84L2/3	84L3/3	85E1/3	85E2/3	85E3/3	85L1/3	85L2/3	85L3/3	92E1/3	92E3/3	93C2/3	93C3/3	93L1/3	93L2/3	93L3/3
Anisops sardeus																
Anisops sp.										1	1	1				
Corixa affinis																
Corixinae	2		2													
Cymatia rogenhoferi																
Gerris argentatus																
Gerris asper	6	6	2													
Gerris gibbifer			2													
Gerris sp.	2	6	2													
Gerris thoracicus		2	4													
Hesperocorixa linnaei																
Mesovelia vittigera																
Micronecta scholtzi				Present	Present	Present	Present	Present	Present	Present	Present	1	6	Present		
Micronecta sp.				Present	Present	Present	Present	Present	Present	Present	Present	1	29	Present	26	6
Microvelia pygmaea			4													
Naucoris maculatus																
Nepa cinerea			2													
Notonecta maculata		10														
Notonecta sp.																
Notonecta viridis viridis																
Sigara lateralis																

Table (9.5): Aquatic Heteroptera collected from stations 104 and 107 during July 1998. Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat; E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	104C1/3	104C2/3	104C3/3	104E1/3	104E2/3	104E3/3	104L1/3	104L2/3	104L3/3	107C1/3	107C2/3	107C3/3	107E1/3	107E2/3	107E3/3	107L1/3	107L2/3	107L3/3
Anisops sardeus		2		9	3	4				1			2					
Anisops sp.	30	11	61	9	6	3	3	5		14	1	1		1	9			
Corixa affinis																		
Corixinae																	3	
Cymatia rogenhoferi										1								
Gerris argentatus																		
Gerris asper																		
Gerris gibbifer																		
Gerris sp.																		
Gerris thoracicus																		
Hesperocorixa linnaei																		
Mesovelia vittigera																		
Micronecta scholtzi				1	2	5	528	20	10	> 100	> 100	> 100	> 100	> 100	Present	> 100	3238	> 100
Micronecta sp.			1		1	1	144	6	4	> 100	> 100	> 100	> 100	> 100	Present	> 100	1898	> 100
Microvelia pygmaea																		
Naucoris maculatus			1							18	4	18	1					
Nepa cinerea																		
Notonecta maculata																		
Notonecta sp.																		
Notonecta viridis viridis																		
Sigara lateralis																		

Table (10): Adults of aquatic Coleoptera collected from the study stations of the Southeast Regional Park during July 1998 Code/Habitat/Replica indicate the station code, habitat types (L: Non-vegetated habitat, E: Cattails; C: Reeds; Ch: Charophytes) and finally the number of replica.

Code/Habitat/Replica	8E1/3	841/3	842/3	841/3	85E2/3	85E3/3	92E1/3	107C1/3	107E1/3	107E2/3	118L2/3	118L3/3
Dryops luridus			1									
Agabus bipustulatus		3	18	2								
Agabus nebulosus		3										
Colymbetes fuscus			1									
Graptodytes flavipes		1	1									
Hydroglyphus geminus		1	1									
Hydroporus pubescens		1	2									
Hygrotus inaequalis											2	2
Laccophilus minutus		3	1	1					3			
Rhantus hispanicus		1										
Rhantus suturalis		2	1									
Stictonectes lepidus			1									
Haliplus lineatocollis		2	5	1								
Limnebius sp.			1									
Ochthebius sp.	1				1	1						
Enochrus sp. cfr. *bicolor*							1					
Helochares lividus	1							1		1		
Hydrobius fuscipes		2	11	2								
Noterus laevis												5