*Graellsia, 77(2): e149*
julio-diciembre 2021
ISSN-L: 0367-5041
https://doi.org/10.3989/graellsia.2021.v77.311

# NEW DATA ON THE BIODIVERSITY AND CHOROLOGY OF AQUATIC INSECTS (ODONATA, COLEOPTERA AND HEMIPTERA) OF MARTIL BASIN (NORTHWESTERN MOROCCO)

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## ABSTRACT

New records on aquatic insects (Coleoptera, Odonata and Hemiptera), collected seasonally from Autumn 2015 to Spring 2018 at a total of 20 sites in the Mediterranean Martil River basin in Northwestern Morocco are presented. An annotated list of 102 species identified from 6,596 individuals collected from recent investigations is provided. These species are grouped into 61 genera, 27 families and 102 species divided into 13 species of Odonata, 65 species of Coleoptera and 24 of Hemiptera. *Helophorus atlantis* is newly recorded from the Rif region, *Hydroporus memnonius* and *Hydroporus rifensis* are new to the Occidental Rif, while *Zygonyx torridus*, *Peltodytes caesus*, *Agabus conspersus*, *Hydroporus rifensis*, *Deronectes theryi*, *Hydrochus grandicollis*, *Hydroporus memnonius*, *Helochares punctatus*, *Hydrochus grandicollis*, *Gerris brasili*, *Hebrus pusillus*, *Parasigara rivularis* and *Notonecta obliqua* are cited for the first time in Martil basin. Taxa richness and abundance were higher in spring and the beginning of summer compared to autumn and winter. A biogeographical analysis shows that the three aquatic insect orders of the Martil River basin are essentially Mediterranean (52%) and Palaearctic (31%) elements, while wide distribution elements are a minority (17%). Taxonomic composition exhibited strong variability among sites and seasons in response to the levels of intermittency and human pressures. These include agricultural, industrial and urban activities, construction of dams and rehabilitation projects operating at the level of the Martil River, altering its ecological status and creating good opportunities for the establishment of alien species such as *Trichocorixa verticalis verticalis*.

**Key words:** aquatic insects, Coleoptera, Hemiptera, Odonata, inventory, new records, Martil basin, Morocco, Mediterranean ecosystems.

## RESUMEN

**Nuevos datos sobre la biodiversidad y corología de insectos acuáticos (Odonata, Coleoptera y Hemiptera) de la cuenca del río Martil (noroeste de Marruecos)**

En el presente estudio se aportan nuevos datos sobre los insectos acuáticos, en particular Odonata, Coleoptera y Hemiptera recolectados estacionalmente desde el otoño de 2015 hasta la primavera de 2018 en un total de 20 estaciones de muestreo en la cuenca mediterránea del río Martil en el noroeste de Marruecos. El estudio taxonómico de 6 596 individuos perteneciendo a estos tres órdenes y recogidos durante el estudio, ha permitido destacar la presencia de 61 géneros, 27 familias y 102 especies repartidos en 13 especies de odonatos, 65 especies de coleópteros y 24 de hemípteros. De estas especies, *Helophorus atlantis* es nueva cita para el Rif, *Hydroporus memnonius* e *Hydroporus rifensis* lo son para el Rif Occidental, mientras que *Zygonyx torridus*, *Peltodytes caesus*, *Agabus conspersus*, *Deronectes theryi*, *Hydrochus grandicollis*, *Gerris brasili*, *Hebrus pusillus*, *Parasigara rivularis* y *Notonecta obliqua* se citan por primera vez en la cuenca del río Martil. La riqueza y abundancia de los tres órdenes fue mayor en primavera y principios de verano en comparación con otoño e invierno. El análisis biogeográfico muestra que los coleópteros, odonatos, y hemípteros de la cuenca del rio Martil están constituidos fundamentalmente por elementos mediterráneos (52%) y paleárticos (31%),

mientras que los elementos de amplia difusión constituyen una minoría (17%). La composición taxonómica exhibió una fuerte variabilidad entre estaciones de muestreo y del año en respuesta a los niveles de intermitencia y presiones humanas, tales como actividades agrícolas, industriales y urbanas, construcción de represas y proyectos de rehabilitación que operan al nivel del río Martil alterando su estado ecológico y creando una buena oportunidad para el establecimiento de especies exóticas como *Trichocorixa verticalis verticalis*.

**Palabras clave:** insectos acuáticos, Coleoptera, Hemiptera, Odonata, inventario, nuevos registros, cuenca del río Martil, Marruecos, ecosistemas mediterráneos.

**Recibido/*Received:*** 12/03/2021; **Aceptado/*Accepted:*** 16/08/2021; **Publicado en línea/*Published online:*** 17/11/2021

**Cómo citar este artículo/*Citation:*** Guellaf, A., Bennas, N., El Haissoufi, M., L'Mohdi, O. & Kettani, K. 2021. New data on the biodiversity and chorology of aquatic insects (Odonata, Coleoptera and Hemiptera) of Martil Basin (northwestern Morocco). *Graellsia*, 77(2): e149. https://doi.org/10.3989/graellsia.2021.v77.311

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## Introduction

Streams in the Mediterranean regions are shaped by sequential, unpredictable, seasonal events of flooding and drying over an annual cycle (Sánchez-Montoya, 2008). In addition to this intrinsic stress, they are subjected to intense human pressures, like flow regulation, intensive agriculture land use and diverse sources of pollution (Gasith & Resh, 1999; Prat & Munné, 2000; Bonada *et al*., 2007). These impacts affect both their aquatic and riparian biotic communities (Bruno *et al*., 2014).

Bioassessment approaches and biodiversity inventories are major conservation tools (Moore *et al*., 2003; Sánchez-Fernández *et al*., 2006), directed to assess and reduce the loss of biodiversity. However, ecological and biological information are still lacking for rivers in the less-developed countries of the Mediterannean region, which are also less successful in the implementation of sustainable river management policies and species conservation programs (Bonada & Resh, 2013; Taybi *et al*., 2018).

Odonata, Coleoptera, and Hemiptera (OCH) are aquatic invertebrates with a high dispersal capacity in a large variety of aquatic habitats. They inhabit pratically all kinds of fresh and brackish water habitats, from the smallest ponds to lagoons and wetlands, and from streams to irrigation ditches (Abellán *et al*., 2005). They can withstand a large range of environmental and anthropogenic stresses at different spatial and temporal scales (Abellán *et al*., 2005; Carbonell *et al*., 2011; Touaylia *et al*., 2013; Abdul *et al*., 2017), providing a large contribution to the species richness of aquatic insects in the Mediterranean area (Ribera *et al*., 2003; Abdul *et al*., 2017). Likewise, OCH have developed a great variety of morphological and ecological adaptations to seasonal variation and the deterioration of habitat quality (Jäch & Balke, 2008; Pérez-Bilbao *et al*., 2014) and are good indicators of environmental disturbance (Tierno de Figueroa *et al*., 2013; Villalobos-Jiménez *et al*., 2016). Thus, it is necessary to characterize chorotypes and the zoogeographic distribution of OCH taxa, and to consider this biogeographical approach as an important functional tool to assess changes in the composition of aquatic communities and identify areas of high biodiversity and endemism (Sánchez-Fernández *et al*., 2006; Tierno de Figueroa *et al*., 2013; Villalobos-Jiménez *et al*., 2016).

The complex biogeographical history combined with its paleogeographic antecedents and its proximity to the Iberian Peninsula made the Rif an exceptional Mediterranean refugial area with high endemism levels and an appropriate region for faunistic and biogeographical studies (Bennas *et al*., 1992; Blondel *et al*., 2010). In this context, we selected the Martil bassin in Northwestern Morocco, at the Mediterranean Intercontinental Biosphere Reserve, to undertake a bioassessment of OCH taxa assemblages under the impact of strong climatic gradients and high levels of human disturbance.

In recent years, significant efforts have been directed towards studying the ecological status and biogeographical patterns of freshwater organisms in Morocco, but the knowledge of the benthic communities at the specific level remains insufficient, which requires the integration of biotic approaches and bioassessment of aquatic ecosystems in ecological management programs to obtain a broad overview of the state of aquatic biodiversity in Morocco (Tierno de Figueroa *et al*., 2013; Slimani *et al*., 2016).

The goals of the current study are (1) to identify the OCH communities and species assemblages occuring in the Martil basin as well as the identification of the chorotypes to which they belong, (2) to provide information on the changes in the patterns of abundance and OCH taxa richness in response to the spatio-temporal variability of environmental gradients, and (3) to enhance our knowledge of the OCH distribution and specific richness across this Mediterranean river.

## Material and methods

### Study area

The study was performed in the Martil basin located in the Northwestern of Morocco, which is part of the Tangier-Tetouan-Al Hoceima region. Martil watershed is relatively small, encompassing an area of 1259 km$^2$ (Oualad Mansour *et al*., 2009).

The hydrographic network of the Martil basin is divided into an upper section with steeply sloping streams in the mountain peaks, which join up in streams with more moderate slopes and end up converging downstream in the main river, Oued Martil, which has appropriated the same name as that of the watershed. This latter is born in Tamouda from the confluence of its main tributaries (Oueds Mhajrat, Khemis, and Chekkoûr). The most features that represent the streams in this basin are intermittency, irregularity of the hydrological regime, and the shortness of the streams length due to the proximity of the mountains (upstreams) to the sea.

The landscape characteristics include high areas occupied by relatively dense forest cover and those in the medium altitude areas are generally occupied by traditional and relatively limited agricultural practices while lowlands are covered by the agricultural, industrial and urban areas allowing a high variability in aquatic ecosystems in the Martil basin.

Rainfalls are irregular with the average annual precipitation varying between 500 and 750 mm/year. The climate of the study area is mainly Mediterranean with an average annual temperature ranging from 15 to 19°C (Karrouchi *et al*., 2016).

### Sampling

A total of 20 sampling sites based on various criteria such as accessibility, distribution throughout the basin to cover different localities (Table 1), upstream/downstream positioning, and sources of pollution were sampled seasonally from Autumn 2015 to Spring 2018, except for the Autumn of 2016 where there was a severe period of drought that caused most streams to dry up and lowering of water level in dams.

Macroinvertebrate samples (adult and larvae) were collected seasonally to detect variabilities in the OCH assemblage using a Surber sampler (20 × 20 cm) and kick technique with a standard hand net (25 × 25 cm) in order to take into account all available microhabitats likely to host OCH taxa. The organisms were sorted and preserved in a plastic box in alcohol for later identification.

In the laboratory, all specimens belonging to the OCH families have been separated and identified firstly to family level under a binocular microscope using taxonomic keys of Sansoni (1992) and Tachet *et al.* (2002), and subsequently identified to species level with the help of specialists who are quoted as co-authors in this present paper.

The chorological category for each species was ranked according to the classification by La Greca (1964, 1975) and Vigna Taglianti *et al.* (1999).

Table 1.— List of localities, streams characteristics, and geographical coordinates of the sampled sites in Martil River basin.

Tabla 1.— Lista de localidades, características de los ríos y coordenadas geográficas de las estaciones de muestreo en la cuenca del río Martil.

| Sampling code | Stream Name | Locality | Hydrological feature | Altitude (m) | Latitude (N) | Longitude (E) |
|---|---|---|---|---|---|---|
| S1 | Tkaraa | Amsemlil | Permanent | 1062 | 35.260853 | -5.433088 |
| S2 | Taida | Taida | Permanent | 505 | 35.368489 | -5.537077 |
| S3 | Khemis | Khemis Anjra | Intermittent | 63 | 35.666099 | -5.505862 |
| S4 | Nakhla | Beni Moussa | Permanent | 300 | 35.393437 | -5.364708 |
| S5 | Hamma | Hamma | Intermittent | 204 | 35.389764 | -5.49841 |
| S6 | Zarka | Kitane | Permanent | 33 | 35.542186 | -5.341914 |
| S7 | Khemis | Souk Lakdim | Ephemeral | 34 | 35.61406 | -5.495428 |
| S8 | El Kkbir | Beni Ider | Permanent | 191 | 35.390201 | -5.490493 |
| S9 | El Kkbir | Koudiet Krikra | Intermittent | 164 | 35.412099 | -5.458864 |
| S10 | Nakhla | Amtil | Intermittent | 217 | 35.426507 | -5.392345 |
| S11 | Nakhla | Koudiet Krikra | Permanent | 115 | 35.453238 | -5.425047 |
| S12 | Khemis | Saddina | Ephemeral | 17 | 35.576058 | -5.472726 |
| S13 | Chekkoûr | Amzal | Ephemeral | 13 | 35.555426 | -5.459121 |
| S14 | Mhajrat | Ben Karrich | Ephemeral | 20 | 35.521951 | -5.440142 |
| S15 | Martil | Laouzyene | Ephemeral | 11 | 35.560363 | -5.431216 |
| S16 | Martil | Tamouda | Permanent | 10 | 35.561271 | -5.416152 |
| S17 | Martil | Taboula | Permanent | 10 | 35.566403 | -5.407741 |
| S18 | Martil | Roumana | Permanent | 8 | 35.559141 | -5.387614 |
| S19 | Martil | Coelma | Permanent | 5 | 35.565425 | -5.35002 |
| S20 | Martil | Diza | Permanent | 1 | 35.599797 | -5.284467 |

The following abbreviations have been used in the material examined following each species: L – Larvae, A – Adult.

## Results

The examination of 6596 individuals of Odonata, Coleoptera and Hemiptera collected from the twenty sites in Martil basin enabled us to identify 102 species grouped in 61 genera and 27 families.

Coleoptera was the most dominant order, which contains the highest number of species recorded in the Martil basin, represented by 10 families, 32 genera and 65 species, followed by Hemiptera with 9 families, 15 genera and 24 species, while Odonata was represented by 7 families, 13 genera and 13 species. Dytiscidae was the most dominant family comprising the highest species diversity (22 species) in our study area, while *Agabus* Leach, 1817, *Hydroporus* Clairville, 1806 (Dytiscidae) and *Hydraena* Kugelann, 1794 (Hydraenidae) were the most diverse genera (5 species). As regards to species, *Aulonogyrus striatus* (Fabricius, 1792) (Gyrinidae, Coleoptera) was the most dominant and common species in the Martil basin, occurring at 19 stations with 19% of the total OCH samples.

Seasonal trends exhibited great contrasts in the abundance and diversity of OCH taxa between seasons. Indeed, species richness ranged from 59 species recorded in Spring 2017 to 19 species reported in Autumn 2015, whereas the abundance varied between 1411 individuals observed in Summer 2016 and 198 observed in Winter 2017 (Fig. 1).

Referring to the studied sites, Oued Tkaraa (S1) which is located in the protected Natural Park of Bouhachem was the station with the greatest species richness and abundance (51 species and 747 individuals). In addition, it is important to highlight that 14 species were exclusively reported in this station (S1), whereas at the nearest station to the mouth of Martil River (downstream), represented by the station Diza (S20), we only recorded one species (*Sigara lateralis*) throughout the sampling period (Fig. 2).

A total of 89 species were recorded from permanent sites (S1, S2, S4, S6, S8 and S11), whereas 55 species were observed in intermittent stations (S3, S5, S9, S10), 48 species were encountered in ephemeral localities (S7, S12, S13, S14, S15) and finally only 36 species were found in the highly impacted permanent stations downstream (S16, S17, S18, S19, S20) (Fig. 3).

The following checklist provides information on the material examined, the chorotype, the habitat where the species was found, and on the regional and global distribution of each species found in the Martil basin during our survey period.

## ODONATA

Family CALOPTERYGIDAE Buchecker, 1876

***Calopteryx haemorrhoidalis*** (Vander Linden, 1825)

Material examined. **S3:** 16-V-2018 (1 L); **S15:** 21-V-2018 (1 L).

Chorotype. W-Mediterranean.

Habitat. This species frequents all types of running water, including fast mountain streams (Jacquemin & Boudot, 1999).

Regional distribution. Common species in northern Morocco, Algeria and Tunisia, and mentioned in the main bioclimatic areas in these countries including the Saharan zone (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot *et al*., 2009; Boudot & De Knijf, 2012; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

Family LESTIDAE Selys, 1840

***Chalcolestes viridis*** Vander Linden, 1825

Material examined. **S2:** 28-IV-2017 (1 L), 19-VI-2017 (4 L); **S3:** 20-V-2016 (6 L), 16-V-2018 (2 L); **S12:** 16-V-2018 (1 L); **S19:** 26-V-2017 (3 L).

Chorotype. W-Palaearctic.

Habitat. This species characterizes the habitats from the smallest streams to the largest rivers bordered by busches and trees with soft bark (El Haissoufi *et al*., 2008).

Regional distribution. *Chalcolestes viridis* extends from the northwest of Morocco to the Central Plateaus of the Middle Atlas and the eastern region, from where it extends eastwards up to northern Tunisia (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot & De Knijf, 2012; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

Family COENAGIONIDAE Kirby, 1890

***Ischnura graellsii*** (Rambur, 1842)

Material examined. **S19:** 16-II-2018 (6 L).

Chorotype. W-Mediterranean.

Habitat. This species is mainly found in running waters (Jacquemin & Boudot, 1999).

Regional distribution. Widely distributed throughout the north and the west of Morocco, Algeria and Tunisia, but mostly replaced by *Ischnura saharensis* south of the Atlas ranges although both species are sympatric and syntopic in the Moulouya River basin (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot *et al*., 2009; Boudot & De Knijf, 2012; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

***Pyrrhosoma nymphula*** (Sulzer, 1776)

Material examined. **S1:** 18-III-2017 (1 L), 29-IV-2017 (1 L).

Chorotype. Palaearctic.

Habitat. Strictly confined to springs and brooks of the medium mountains (Jacquemin & Boudot, 1999; Boudot 2008; Boudot & De Knijf 2012).

Regional distribution. In Morocco, the range of this species is limited to the Rif Mountains, the Middle and the High Atlas, and the Eastern region (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot & De Knijf, 2012; Waldhauser, 2012; El Haissoufi *et al*., 2015). During our investigations in the Martil basin, *P. nymphula* was only found in Oued Tkaraa (S1).

Family AESHNIDAE Selys, 1850

***Aeshna mixta*** (Latreille, 1805)

Material examined. **S3:** 16-V-2018 (1 L); **S15:** 21-V-2018 (1 L).

Chorotype. Palaearctic.

Habitat. This species seems to prefer marshes and rivers with low current in lowlands areas, although it aestivate in summer at hiher altitude (Samraoui *et al*. 1998; Jacquemin & Boudot, 1999; Boudot, 2008; El Haissoufi *et al*., 2010; Boudot & De Knijf, 2012).

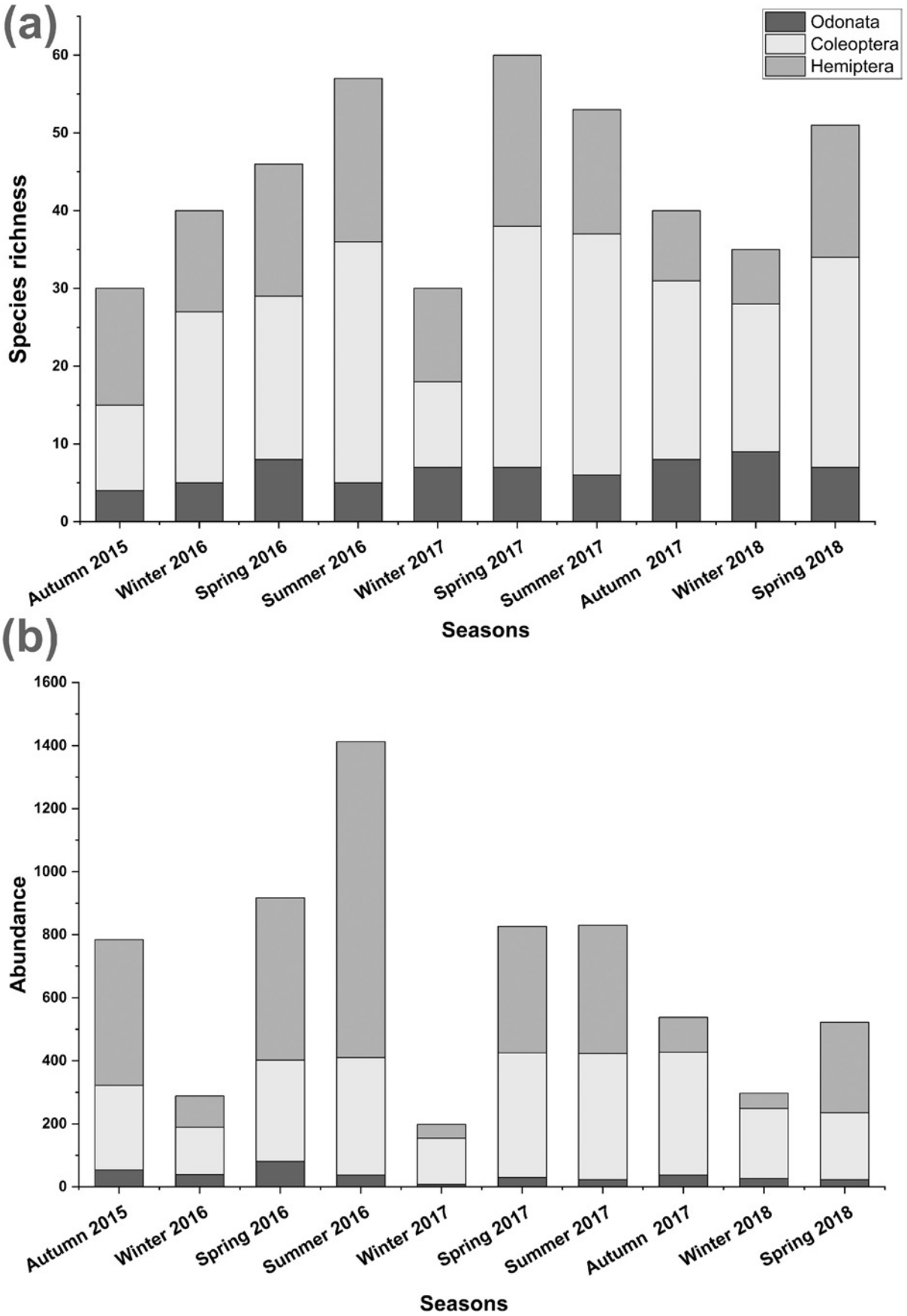


Fig. 1.— Seasonal variation of species richness (a) and abundance (b) of OCH during our study period at Martil River basin.

Fig. 1.— Variación estacional de la riqueza de especies (a) y abundancia (b) de OCH durante el período de estudio en la cuenca del río Martil.

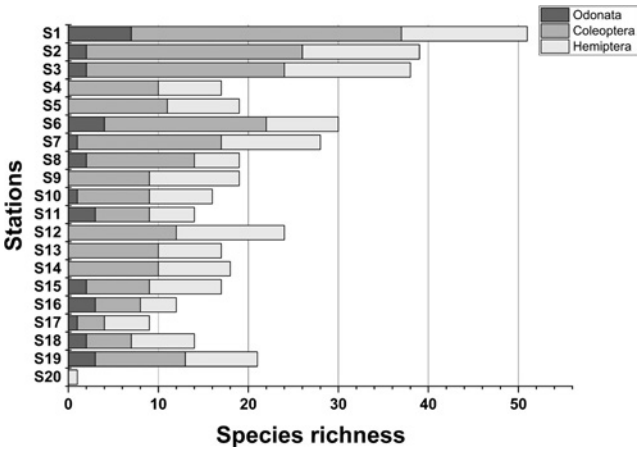


Fig. 2.— Variation of species richness between the sampled stations during the study period at Martil River basin.

Fig. 2.— Variación de la riqueza de especies de OCH entre las estaciones de muestreo durante el período de estudio en la cuenca del río Martil.

Regional distribution. In Morocco, *A. mixta* was reported from the Middle Atlas, Central Plateau, the Rif domain and recently in the Eastern Morocco (Jacquemin & Boudot, 1999, El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

***Boyeria irene*** (Fonscolombe, 1838)

Material examined. **S1:** 20-V-2016 (1 L), 17-III-2017 (1 L), 27-IV-2017 (1 L); **S2:** 20-V-2016 (2 L), 28-IV-2017 (1 L) , 23-IV-2018 (1 L); **S6:** 11-V-2017, 12-XI-2017 (1 L), 25-I-2018 (1 L); **S8:** 11-III-2017 (1 L), 16-V-2017 (1 L).

Chorotype. W-Mediterranean.

Habitat. This species is mainly associated with fresh water in hilly and mountainous areas (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot & De Knijf, 2012).

Regional distribution. *Boyeria irene* appears preferably in the Maghrebian Atlas and Rif mountain ranges, east up to Tunisia (Jacquemin & Boudot, 1999, Boudot *et al*., 2009; El Haissoufi *et al*., 2015, Taybi *et al*., 2019).

Family GOMPHIDAE Selys, 1850

***Onychogomphus uncatus*** (Charpentier, 1840)

Material examined. **S1:** 24-VI-2016 (1 L), 27-IV-2017 (2 L), 15-VI-2017 (1 L); **S6:** 12-XI-2015 (1 L), 31-III-2016 (6 L), 11-V-2017 (1 L), 12-XI-2017 (1 L), 25-I-2018 (1 L).

Chorotype. W-Mediterranean.

Habitat. This species seems to be regularly present in mountainous streams with swift water (Jacquemin & Boudot, 1999).

Regional distribution. *Onychogomphus uncatus* is commonly associated with the mountainous areas of Morocco (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot & De Knijf, 2012; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

***Onychogomphus forcipatus unguiculatus*** (Vander Linden, 1823)

Material examined. **S1:** 18-III-2016 (1 L); **S6:** 12-XI-2017 (2 L), 25-I-2018 (1 L); **S8:** 11-III-2017 (1 L), 16-V-2017 (1 L).

Chorotype. W-Mediterranean.

Habitat. This *Onychogomphus* is usually found in lotic habitats of wide and deep lowland rivers (El Haissoufi *et al*., 2008).

Regional distribution. This species is widespread in northern Morocco, the Middle Atlas, the Central Plateau and the eastern region (Jacquemin & Boudot, 1999; Boudot *et al*., 2009; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

Family CORDULEGASTERIDAE Fraser, 1940

***Cordulegaster boltonii algirica*** Morton, 1916

Material examined. **S1:** 18-XII-2015 (1 L), 18-III-2016 (2 L), 17-II-2017 (2 L), 5-VI-2017 (3 L), 27-IV-2017 (3 L), 20-XI-2017 (3 L).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. This mountainous species reproduces exclusively in running waters (brooks and rivers) (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot *et al*., 2009; Boudot & De Knijf, 2012).

Regional distribution. In Morocco, this species frequents the mountainous areas of the Western and Eastern Rif and the Middle Atlas (Jacquemin & Boudot, 1999; El Haissoufi *et al*., 2015; Taybi *et al*., 2019).

Family LIBELLULIDAE Selys, 1850

***Libellula quadrimaculata*** Linnaeus, 1758

Material examined. **S1:** 20-III-2016 (1 L), 07-III-2017 (1 L); **S10:** 27-I-2018 (1 L).

Chorotype. Holarctic.

Habitat. This species mainly occupies stagnant waters (swamps, pools, ponds and lakes) (Slimani *et al*., 2016).

Regional distribution. In Morocco, this species is mostly confined to the Rif and the Atlas domains (Jacquemin & Boudot, 1999; El Haissoufi *et al*., 2015).

***Sympetrum striolatum*** (Charpentier, 1840)

Material examined. **S1:** 24-VI-2016 (1 L), 15-VI-2017 (12 L), 20-XI-2017 (10 L), 17-I-2018 (6 L).

Chorotype. Palaearctic.

Habitat. This species reproduces in both lotic (brooks) and lentic (marshes, pools, ponds and lakes) waters (Jacquemin & Boudot, 1999; El Haissoufi *et al*., 2008; Boudot & De Knijf, 2012).

Regional distribution. This species was encountered from various sites in the north of Morocco, from where it extends eastwards up to Tunisia (Jacquemin & Boudot, 1999; Boudot *et al*. 2009; El Haissoufi *et al*., 2015; Taybi *et al*., 2019). During our investigation at Martil basin it was only found in Oued Tkaraa (S1).

***Trithemis kirbyi ardens*** (Gerstaecker, 1891)

Material examined. **S7:** 04-I-2018 (1 L).

Chorotype. Afrotropical-Palaearctic.

Habitat. Species usually frequent in rocky localities with poor vegetation (Jacquemin & Boudot, 1999).

Regional distribution. In Morocco, this *Trithemis* has been cited especially in arid and semi-arid mountainous areas. It has been recently reported from the Rif region. Our record from Oued Khemis is the most northern locality known so far for this species in our country (Jacquemin & Boudot, 1999; El Haissoufi *et al*., 2015; Taybi *et al*., 2019). Taking advantage of several heat waves since the turn of the millenium, *T. kirbyi* shows a fast northwards expantion and invaded recently the main part of the Iberian Peninsula from 2007 to 2016, reaching ultimately the south of France, where it is now reproducing (Polette *et al.*, 2017; Doniol-Valcroze *et al.*, 2021).

***Zygonyx torridus*** (Kirby, 1889)

Material examined. **S11:** 10-I-2018 (1 L).

Chorotype. Afrotropical-Palaearctic. It is unclear wether the few Indian records refer to established populations or to only vagrant or migrant individuals.

Habitat. This species reproduces in streams, particularly in streches with fast current and waterfalls, in arid or semi-arid regions (Jacquemin & Boudot, 1999).

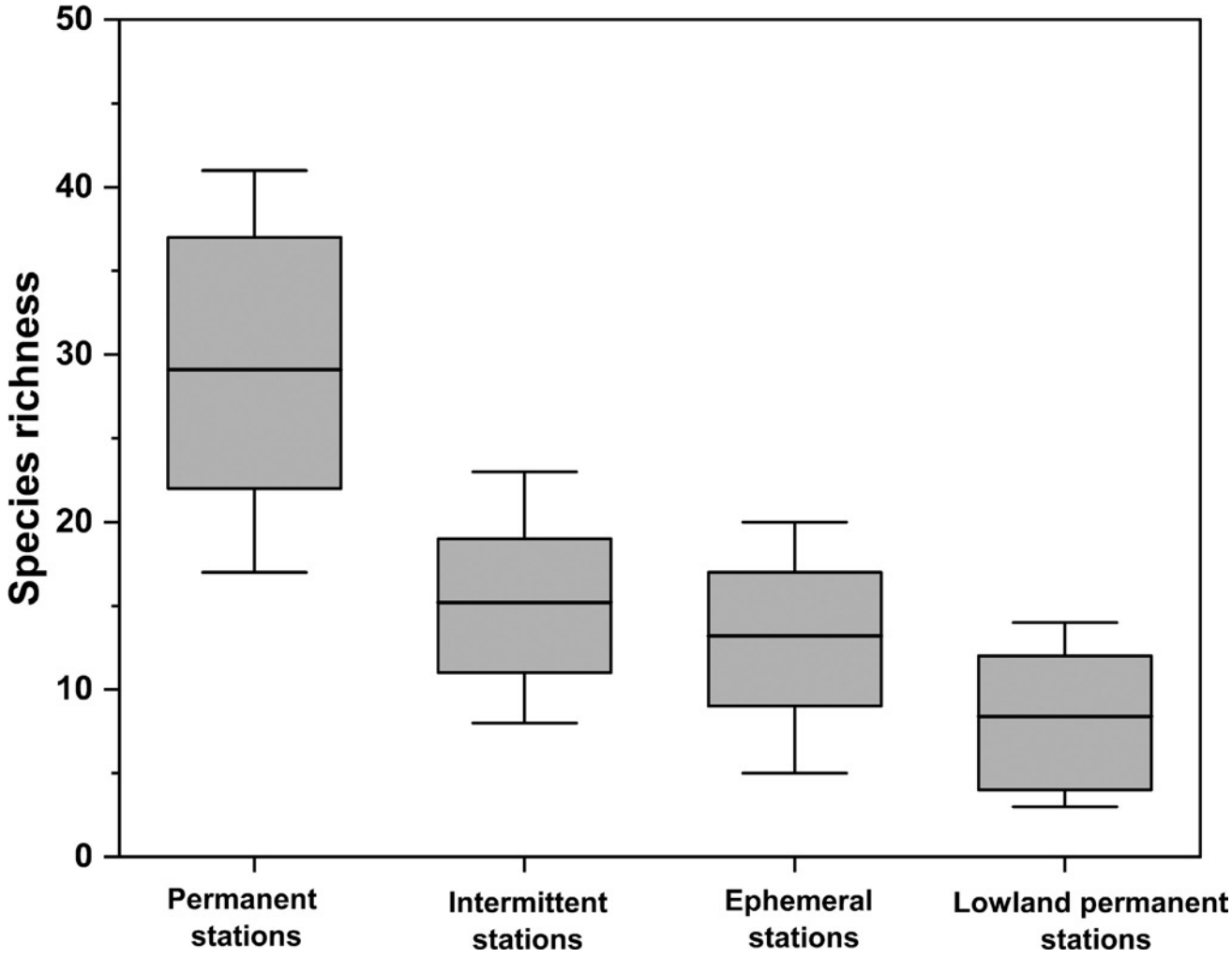


Fig. 3.— Box-plots (median, min-max) showing the variations of species richness of OCH taxa sampled from Martil River basin during the whole study period depending on river types.

Fig. 3.— Diagramas de caja (mediana, min-max) mostrando las variaciones de la riqueza de especies de taxones de OCH muestreados en la cuenca del río Martil durante todo el período de estudio, según los tipos de río.

Regional distribution. This species has been found in some localities in the Atlas Mountains and the eastern region of the country (Jacquemin & Boudot, 1999; Boudot, 2008; Boudot & de Knijf, 2012; Taybi *et al*., 2019). Our research confirms its presence in northwestern Morocco for the first time after earlier captures by Dumont (1972) at Oued Laou (El Haissoufi *et al*., 2008).

## COLEOPTERA

Family GYRINIDAE Thomson, 1860

***Aulonogyrus* (*Aulonogyrus*) *striatus*** (Fabricius, 1792)

Material examined. **S1:** 18-III-2016 (2 A), 29-IV-2016 (1 A), 7-II-2017 (1 A), 15-VI-2017 (2 A), 14-II-2018 (1 A); **S2:** 29-V-2016 (2 A); **S3:** 14-XII-2015 (31 A), 17-III-2016 (4 A), 15-VI-2016 (2 A), 8-III-2017 (1 A), 27-V-2017 (2 A), 16-V-2018 (4 A); **S4:** 16-III-2016 (8 A) 27-V-2016 (36 A), 22-VI-2016 (59 A), 19-III-2017 (1 A), 24-V-2017 (27 A), 12-VI-2017 (11 A), 8-XII-2017 (37 A), 27-I-2018 (10 A), 14-IV-2018 (4 A); **S5:** 19-XII-2015 (2 A) 4-IV-2016 (7 A), 24-VI-2016 (6 A), 11-III-2017 (4 A), 18-VI-2017 (56 A); **S6:** 11-XII-2015 (50 A) 15-III-2016 (15 A) 31-IV-2016 (17 A), 26-VI-2016 (28 A), 11-V-2017 (7 A), 16-VI-2017 (30 A), 12-XII-2017 (124 A), 25-I-2018 (10 A), 18-V-2018 (8 A); **S7:** 17-III-2016 (1 A) 20-V-2016 (8 A), 15-VI-2016 (1 A), 27-V-2017 (33 A), 17-VI-2017 (11 A), 16-V-2018 (1 A); **S8:** 29-V-2016 (29 A), 24-VI-2016 (14 A), 11-III-2017 (18 A), 16-V-2017 (19 A), 18-VI-2017 (22 A), 18-II-2018 (4 A); **S9:** 19-XII-2015 (3 A) 29-V-2016 (3 A), 11-III-2017 (5 A), 16-V-2017 (1 A), 18-VI-2017 (17 A), 15-XII-2017 (1 A), 18-II-2018 (8 A), 23-IV-2018 (2 A); **S10:** 23-V-2016 (25 A), 24-VI-2016 (9 A), 22-VI-2016 (38 A), 16-V-217 (29 A), 12-VI-2017 (21 A), 11-XII-2017 (14 A), 27-I-2018 (25 A), 14-V-2018 (12 A); **S11:** 20-XII-2015 (46 A), 15-III2016 (5 A) 23-V-2016 (7 A), 22-VI-2016 (4 A), 25-V-2017 (1 A), 18-VI-2017 (3 A), 11-XII-2017 (1 A); **S12:** 20-V-2016 (1 A), 27-V-2017 (45 A), 17-VI-2017 (8 A); **S13:** 20-V-2016 (9 A), 19-VI2016 (2 A), 8-III-2017 (1 A), 26-V-2017 (10 A), 11-VI-2017 (7 A), 16-V-2018 (5 A); **S14:** 13-XII-2015 (25 A), 23-V-2016 (4 A), 11-VI-2017 (7 A), 07-I-2018 (1 A), 16-V-2018 (4 A); **S15:** 3-VI-2016 (1 A), 16-VI-2016 (2 A), 8-III-2017 (1 A), 28-V-2017 (3 A), 12-VI-2017 (11 A)**; S16:** 3-III-2016 (2 A), 16-VI-2016 (1 A), 28-V-2017 (2 A), 13-VI-2017 (1 A); **S17:** 3-III-2016 (2 A); **S18:** 4-VI-2016 (4 A); **S19:** 18-XII-2015 (32 A), 4-VI-2016 (14 A), 26-V-2017 (2 A).

Chorotype. Holo-Mediterranean.

Habitat. This species occurs in various aquatic habitats such as puddle, backwaters and freshwater (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Common species in Morocco especially in its northern part (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a), with a widespread distribution in the Martil River basin.

***Gyrinus* (*Gyrinus*) *caspius*** Ménétries, 1832

Material examined. **S3:** 20-V-2016 (3 A); **S6:** 26-VI-2016 (2 A); **S8:** 19-XII-2015 (1 A); **S14:** 12-VI-2017 (1 A).

Chorotype. Centralasiatic-Europeo-Mediterranean.

Habitat. The species seems to prefer pools, ponds, puddles and slowly flowing streams (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Moroccan distribution area of *Gyrinus caspius* is restricted to the Rif, Middle Atlas and central plateau (Bennas & Sáinz-Cantero, 2006; Benamar *et al*., 2021a). In our study area, it was found infrequently in some middle streams.

***Gyrinus* (*Gyrinus*) *dejeani*** Brullé, 1832

Material examined. **S1:** 29-IV-2016 (13 A), 20-VI-2016 (15 A), 27-IV-2017 (9 A), 15-VI-2017 (1 A), 20-XI-2017 (4 A), 14-II-2018 (1 A), 12-V-2018 (4 A); **S2:** 29-V-2016 (3 A), 26-VI-2016 (5 A), 28-V-2017 (12 A), 19-VI-2017 (2 A), 11-XII-2017 (7 A), 23-IV-2018**; S3:** 15-VI-2016 (1 A), 27-V-2017 (3 A), 16-V-2018 (3 A); **S4:** 16-III-2016 (2 A), 27-V-2016 (1 A), 24-V-2017 (2 A), 12-VI-2017 (3 A), 8-XII-2017 (1 A); **S5:** 28-IV-2017 (3 A), 23-V-2018 (7 A); **S6:** 11-XII-2015 (3 A), 15-III-2016 (4 A), 11-V-2017 (1 A), 16-VI-2017 (1 A), 25-I-2018 (4 A), 18-V-2018 (5 A); **S7:** 27-V-2017 (1 A), 16-V-2018 (11 A); **S8:** 16-V-2017 (2 A), 13-V-2018 (1 A); **S9:** 24-VI-2016 (1 A), 18-II-2018 (3 A), 23-IV-2018 (1 A); **S10:** 23-V-2016 (2 A); **S11:** 11-XII-2015 (3 A): 16-V-2017 (2 A); **S12:** 20-V-2016 (1 A), 27-V-2017 (2 A), 17-VI-2017 (3 A), 16-V-2018 (2 A); **S13:** 19-VI2016 (1 A), 26-V-2017 (1 A); **S14:** 28-V-2017 (3 A), 12-VI-2017 (1 A); **S15:** 12-VI-2017 (1 A); **S16:** 3-VI-2016 (1 A); **S19:** 4-VI-2016 (1 A), 19-VI2016 (16 A), 26-V-2017 (2 A), 10-VI-2017 (1 A), 18-V-2018 (7 A).

Chorotype. Holo-Mediterranean.

Habitat. Typical of pools, ponds and slowly flowing streams (Kıyak *et al*., 2006; Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species appears as a common species in Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Benamar *et al*., 2021a), including Martil River basin.

***Gyrinus* (*Gyrinus*) *urinator*** Illiger, 1807

Material examined. **S1:** 20-VI-2016 (2 A); **S2:** 26-VI-2016 (15 A), 28-V-2017 (3 A), 19-VI-2017 (25 A), 18-II-2018 (1 A); **S3:** 17-III-2016; 20-V-2016 (18 A), 15-VI-2016 (5 A), 8-III-2017 (1 A), 27-V-2017 (6 A), 17-VI-2017 (9 A), 04-I-2018 (5 A), 16-V-2018 (21 A); **S5:** 24-VI-2016 (6 A), 11-III-2017 (1 A), 18-VI-2017 (5 A), 23-V-2018 (3 A); **S6:** 26-VI-2016 (2 A), 25-I-2018 (4 A); **S7:** 15-VI-2016 (2 A), 27-V-2017 (2 A), 17-VI-2017 (4 A); **S8:** 18-VI-2017 (6 A), 13-V-2018 (5 A); **S9:** 29-V-2016 (1 A), 23-IV-2018 (1 A); **S10:** 22-VI-2016 (2 A), 27-I-2018 (5 A); **S11:** 23-V-2016 (3 A), 18-VI-2017 (1 A); **S12:** 20-V-2016 (2 A), 15-VI-2016 (10 A), 27-V-2017 (4 A), 17-VI-2017 (13 A), 16-V-2018 (3 A); **S13:** 19-VI2016 (5 A), 26-V-2017 (1 A); **S14:** 28-V-2017 (3 A); **S15:** 12-VI-2017 (3 A); **S19:** 4-VI-2016 (3 A), 19-VI2016 (16 A).

Chorotype. Holo-Mediterranean.

Habitat. This species appears preferably in areas paddled with rivers and streams, but also in ponds (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Widely distributed in the northern and eastern parts of Morocco with an extension to the Middle and High Atlas (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a). In Martil River basin the species was captured from upstream to downstream.

***Orectochilus villosus bellieri*** Reiche, 1861

Material examined. **S6:** 31-IV-2016 (4 A).

Chorotype. W-Mediterranean.

Habitat. This *Orectochilus* appears in rivers and streams, mainly on the banks of quiet areas. This nocturnal species is often submerged with great ability to dive (Bennas & Sáinz-Cantero, 2006; Millán *et al*., 2014).

Regional distribution. In Morocco, its geographic distribution is mainly restricted to a few localities in the mains geographic domains of the country (Bennas & Sáinz-Cantero, 2006; Benamar *et al*., 2021a). Rare species in the Rif, only known from two sites belonging to Laou River basin (Benamar *et al*., 2011). It was captured only in Oued Zarka (S6) during our sampling period.

Family HALIPLIDAE Thomson, 1860

***Haliplus* (*Neohaliplus*) *lineatocollis*** (Marsham 1802)

Material examined. **S3:** 20-V-2ax016 (1 A), 14-XII-2017 (2 A); **S7:** 15-VI-2016 (1 A); **S14:** 13-XII-2015 (2 A); **S18:** 18-XII-2015 (1 A).

Chorotype. Palaearctic-Afrotropical.

Habitat. Typical in rivers, pools and ponds, but it can also be found in any water bodies, lotic or lentic, soft or brackish (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Widely distributed in different geographic domains of Morocco, especially in its northwestern corner (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Benamar *et al*., 2021a). The species was collected from some fairly scattered localities all over our study area.

***Peltodytes caesus*** (Duftschmid, 1805)

Material examined. **S3**: 8-III-2017 (1 A), 04-I-2018 (1 A).

Chorotype. Palaearctic.

Habitat. This species can be found in a wide variety of habitats, such as backwaters of rivers, pools, ponds and lagoons with macrophytes (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Wide distribution patterns, with a fragmented range in the north of Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Benamar *et al*., 2021a). Our samples in the upstream of Oued Khemis (S3) represent the first record of this species from Martil basin.

***Peltodytes rotundatus*** (Aubé, 1836)

Material examined. **S3**: 17-VI-2017 (1 A).

Chorotype. Holo-Mediterranean.

Habitat. This species prefers backwaters of streams and rivers, also pools and ponds, always with macrophytes (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Cited from several localities throughout the mains domains of the country (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Chakour *et al*., 2017; Benamar *et al*., 2021a). This species was encountered only in the upper part of Oued Khemis (S3) in our study.

Family NOTERIDAE Bedel, 1880

***Noterus laevis*** Sturm, 1834

Material examined. **S1:** 18-III-2016 (13 A), 29-IV-2016 (3 A), 20-VI-2016 (5 A), 15-VI-2017 (5 A), 20-XI-2017 (1 A), 12-V-2018 (1 A); **S2:** 13-III-2016 (2 A); **S3:** 17-III-2016 (4 A), 20-V-2016 (1 A), 16-V-2018 (2 A); **S18:** 19-VI-2016 (1 A).

Chorotype. W-Mediterranean.

Habitat. Typical of lagoons and permanent freshwater wetlands with a certain degree of mineralization and abundant fine organic matter (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species has been encountered in various sites through Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Benamar *et al*., 2021a). Moreover, *Noterus laevis* have wide altitudinal ranges in Martil Basin.

Family DYTISCIDAE Leach, 1817

***Agabus bipustulatus*** (Linnaeus, 1767)

Material examined. **S1**: 14-II-2018 (1 A).

Chorotype. Palaearctic-Afrotropical.

Habitat. Typical of streams, but also of isolated pools in river stretches. Always in freshwater or little mineralized (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, it was captured in various localities in the Atlas, the Rif and the Oriental region (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). One specimen was captured in sampling site (S1) during our study period.

***Agabus brunneus*** (Fabricius, 1798)

Material examined. **S1**: 15-VI-2017 (1 A), 12-V-2018 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Typical of freshwater streams with macrophytes, appearing under stones in humid areas (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Abundant species in Morocco where it was reported from several localities of the mains geographical domains of the country (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). It was only captured in Oued Tkaraa (S1) from Martil basin during our sampling period.

***Agabus conspersus*** (Marsham, 1802)

Material examined. **S19**: 26-V-2017 (1 A).

Chorotype. Palaearctic.

Habitat. Typical species of ponds and wetlands, especially in water bodies with some degree of eutrophication and mineralization (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Very rare in Morocco in where it was only recorded by two citations dating back to the beginning of the last century. Our capture in the station (S19) located downstream is the first citation of this species in the Martil basin, and the second recent record in Morocco after its citation on the Bouhachem Natural Park (Slimani *et al*., 2016).

***Agabus didymus*** (Olivier, 1795)

Material examined. **S1:** 20-VI-2016 (1 A), 27-IV-2017 (14 A), 15-VI-2017 (9 A), 12-V-2018 (3 A); **S7:** 17-III-2016 (1 A), 17-VI-2017 (1 A), 14-XII-2017 (1 A).

Chorotype. Europeo-Mediterranean.

Habitat. Common species in streams and rivers, although it can also occupy ponds and peat bogs (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Common species in the mains geographic areas of Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a).

***Agabus nebulosus*** (Forster, 1771)

Material examined. **S1:** 27-IV-2017 (6 A), 20-XI-2017 (1 A), 14-II-2018 (1 A); **S2:** 28-V-2017 (1 A).

Chorotype. Europeo-Mediterranean.

Habitat. Typical of ponds and wetlands. It supports a certain degree of eutrophication and mineralization (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Very common species in Morocco especially in its northern part (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a).

***Ilybius chalconatus*** (Panzer, 1796)

Material examined. **S2:** 28-V-2017 (1 A).

Chorotype. Europeo-Mediterranean.

Habitat. This species occupies different types of aquatic habitats (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species is known from a few localities from scattered points in mountainous regions (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a).

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

Material examined. **S19:** 18-V-2018 (1 A).

Chorotype. Palaearctic Oriental.

Habitat. Opportunistic species, typical in newly created habitats. This species prefers stagnant pond water and lagoons, although it appears in backwaters of rivers (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. *Hydroglyphus geminus* is known from several scattered localities all over Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a). Our capture in Coelma constitute the first records for Martil River basin.

***Yola bicarinata*** (Latreille, 1804)

Material examined. **S12:** 15-VI-2016 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Able to colonize different types of habitats, such as pools, ponds, or backwaters of streams, rivers and also in anthropized localities (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species appears widely distributed in Morocco, but mainly in the northern half (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a). Known only from (S12) in the lower part of Oued Khemis.

***Deronectes faimairei*** (Leprieur, 1876)

Material examined. **S1:** 18-III-2016 (2 A), 20-VI-2016 (4 A), 27-IV-2017 (9 A), 15-VI-2017 (8 A), 14-II-2018 (1 A); **S2:** 13-III-2016 (2 A), 26-VI-2016 (2 A), 28-V-2017 (6 A); **S3:** 17-III-2016 (1 A), 8-III-2017 (2 A); **S4:** 16-III-2016 (3 A), 19-III-2017 (1 A), 12-VI-2017 (1 A), 8-XII-2017 (1 A); **S5:** 13-III-2016 (7 A), 28-IV-2017 (12 A), 15-XII-2017 (3 A), 18-II-2018 (1 A), 23-V-2018 (2 A); **S6:** 15-III-2016 (1 A), 26-VI-2016 (1 A), 11-V-2017 (1 A); **S7:** 17-III-2016 (12 A), 27-V-2017 (4 A), 14-XII-2017 (3 A), 04-I-2018 (7 A); **S8:** 16-V-2017 (15 A), 15-XII-2017 (6 A), 18-II-2018 (1 A), 13-V-2018 (2 A); **S9:** 13-III-2016 (5 A), 22-VI-2016 (1 A), 16-V-2017 (3 A), 15-XII-2017 (1 A), 18-II-2018 (1 A), 23-IV-2018 (1 A); **S10:** 11-XII-2017 (1 A); **S11:** 15-III2016 (4 A); **S13:** 26-V-2017 (1 A), 16-V-2018 (2 A); **S14:** 13-V-2018 (3 A); **S15:** 8-III-2017 (1 A), 13-V-2018 (1 A); **S16:** 8-XII-2017 (1 A).

Chorotype. W-Mediterranean.

Habitat. Colonizes streams with wide variety of substrates and tolerates some levels of turbidity and eutrophic waters (Millán *et al*., 2014).

Regional distribution. In Morocco, **i**t was reported from several localities (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). It is the most common Dytiscidae in the Martil basin.

***Deronectes hispanicus*** (Rosenhauer, 1856)

Material examined. **S2:** 13-III-2016 (1 A), 29-V-2016 (1 A), 26-VI-2016 (2 A), 23-IV-2018 (3 A); **S3:** 16-V-2018 (2 A); **S7:**

16-V-2018 (9 A); **S12**: 04-I-2018 (1 A); **S13:** 04-I-2018 (1 A); **S14:** 07-I-2018 (1 A).

Chorotype. W-Mediterranean.

Habitat. Frequent in headwaters, medium-high Mountains, with thick substrates (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Species distributed exclusively in the Rif and Pré-Rif region and one remote locality in the High Atlas (Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Benamar *et al*., 2021a). In Martil River basin, the specie was recorded only in one upstream locality (Benamar *et al*., 2021a). Our study expands its distribution in this basin river.

***Deronectes theryi*** (Peyerimhoff, 1925)

Material examined. S1: 12-V-2018 (1 A).

Chorotype. Moroccan Endemic.

Habitat. This species can be found in well-preserved headwaters, typical of lotic freshwater systems (Bennas & Sáinz-Cantero, 2006; Benamar, 2015).

Regional distribution. All collections of this species in Morocco were in isolated sites in the Occidental Rif, Middle, High and Anti Atlas (Bennas & Sáinz-Cantero, 2006; Benamar *et al*., 2021a). Our catch at Oued Tkaraa (S1) constitutes the first record of this species in the Martil basin.

***Nebrioporus clarkii*** (Wollaston, 1862)

Material examined. **S4:** 8-XII-2017 (1 A); **S14:** 28-V-2017 (1 A).

Chorotype. W-Mediterranean.

Habitat. Found in lotic systems with moderate current velocity (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species is frequently encountered all over Morocco (Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a). It was captured only from two sites in the right side of Martil River basin.

***Hydroporus discretus discretus*** Fairmaire & Brisout, 1859

Material examined. **S1:** 12-XI-2015 (6 A), 18-III-2016 (1 A), 7-II-2017 (2 A), 15-VI-2017 (4 A), 20-XI-2017 (7 A), 14-II-2018 (5 A), 12-V-2018 (6 A); **S2:** 13-III-2016 (1 A), 11-III-2017 (1 A).

Chorotype. W-Palaearctic.

Habitat. Mainly found in streams and pools and associated with river systems which are normally well-preserved sites, although it supports a certain level of eutrophication (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species was found from the northern half of Morocco and from a few localities at the central Plateau, High, Middle and Anti Atlas (Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). In Martil River basin the species was captured in upstreams.

***Hydroporus lucasi*** Reiche, 1866

Material examined. **S1:** 27-IV-2017 (7 A), 20-XI-2017 (1 A), 12-V-2018 (3 A).

Chorotype. W-Mediterranean.

Habitat. Common in upstreams with a wide variety of substrates and habitats, but it abounds in freshwater ponds (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Usually distributed in the northern half of Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). In our study, it was captured only from Oued Tkaraa (S1) at Bouhachem Natural Park.

***Hydroporus memnonius*** Nicolai, 1822

Material examined. **S1:** 15-VI-2017 (1A).

Chorotype. Palaearctic.

Habitat. Mountain species, it predominates in small water bodies, both in forests and in the open field, and often in substrates rich in mosses and leaf litter (Millán *et al*., 2014).

Regional distribution. This species was only once signalled for an isolated locality in the central Rif (Bennas & Sáinz-Cantero, 2006). Our catches in Oued Tkaraa (S1) located at Bouhachem Natural Park constitute the second citation of this species in Morocco, which will expand its range of distribution at the Occidental Rif.

***Hydroporus obsoletus*** Aubé, 1836

Material examined. **S1:** 18-III-2016 (2 A), 27-IV-2017 (1 A), 20-XI-2017 (1 A), 14-II-2018 (2 A), 12-V-2018 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Appears in upstreams and prefers shallow running waters (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species is fairly well-known in Morocco (Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Benamar *et al*., 2021a). It was captured only at Oued Tkaraa (S1) in Bouhachem Natural Park in the upstream of Martil basin.

***Hydroporus rifensis*** (Manuel, 2014)

Material examined. **S1**: 20-VI-2016 (1 A).

Chorotype. Moroccan Endemic.

Habitat. This species can be found in well-preserved lentic water bodies with a shallow depth (Manuel, 2014).

Regional distribution. Distribution area of this endemic species is restricted to its type locality, Anassar Bab Berred in Central Rif (Manuel, 2014). Our catch in Oued Tkaraa at the Bouhachem Natural Park constitutes the first record of this species in the Occidental Rif.

***Graptodytes ignotus*** (Mulsant, 1861)

Material examined. **S2:** 19-XII-2015 (2 A), 11-XII-2017 (1 A); **S12:** 15-VI-2016 (1 A), 04-I-2018 (1 A).

Chorotype. W-Mediterranean.

Habitat. Typical of streams of medium altitude and rivers of small entity, appearing with some frequency in pools and slow sections of these river courses (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Widespread from all geographical domains of Morocco, especially in its northwestern part (Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a).

***Graptodytes varius*** (Aubé, 1836)

Material examined. **S1:** 18-III-2016 (1 A); **S2:** 13-III-2016 (1 A), 26-VI-2016 (2 A); **S3:** 27-V-2017 (1 A), 14-XII-2017 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Typical of backwaters and pools in small streams, with a wide variety of substrates (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Species reported in Morocco from its northern part and some sites in the central plateau, Middle and High Atlas (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimni *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a).

***Stictonectes optatus*** (Seidlitz, 1887)

Material examined. **S1:** 15-VI-2017 (1 A), 15-VI-2017 (1 A); **S2:** 26-VI-2016 (1 A), 28-V-2017 (2 A), 11-XII-2017 (1 A), 18-II-2018 (2 A), 23-IV-2018 (1 A); **S3:** 17-III-2016 (1 A), 15-VI-2016 (3 A), 04-I-2018 (3 A); **S7:** 15-VI-2016 (1 A).

Chorotype. W-Mediterranean.

Habitat. This species prefers slow sections and pools of freshwater streams in mountain areas (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species was recorded from several localities throughout the Rif and on scattered points covering

all Moroccan geographic domains (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a).

***Laccophilus hyalinus*** (De Geer, 1774)
Material examined. **S7:** 15-VI-2016 (1 A).
Chorotype. W-Mediterranean.
Habitat. In middle streams, it prefers areas paddled with aquatic vegetation. It supports eutrophy and high concentration of organic matter (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This species is thought to be the most widely spread dytiscid in Morocco (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Slimani *et al*., 2016; Taybi *et al*., 2017; Benamar *et al*., 2021a). However, it is encountered only in the middle course of Oued Khemis (S7).

***Laccophilus minutus*** (Linnaeus, 1758)
Material examined. **S2:** 17-III-2016 (1 A); **S19:** 26-V-2017 (4 A), 19-VI2016 (2 A), 18-V-2018 (1 A).
Chorotype. Palaearctic-Oriental.
Habitat. Common species in stagnant waters of both permanent and temporary, fresh and eutrophied water bodies (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco, the species is reported from all Moroccan geographic domains (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero, 2006; Taybi *et al*., 2017; Benamar *et al*., 2021a).

Family HELOPHORIDAE Latreille, 1802
***Helophorus algiricus*** (Motschulsky, 1860)
Material examined. **S1:** 27-IV-2017 (1 A); **S10:** 14-V-2018 (1 A).
Chorotype. Endemic Maghrebian.
Habitat. This *Helophorus* can be found in lotic or lentic habitats (Benamar, 2015).
Regional distribution. In Morocco, it was reported in the Rif and in various other scattered localities throughout the country (Chavanon *et al*., 2004; Benamar, 2015; Slimani *et al*., 2016).

***Helophorus atlantis*** Angus & Aouad, 2009
Material examined. **S19:** 26-V-2017 (1 A).
Chorotype. Moroccan Endemic.
Habitat. This species prefers stagnant waters especially in mountainous regions (Benamar, 2015).
Regional distribution. In Morocco, it is generally confined to a few mountainous localities in the Middle Atlas (Angus & Aouad, 2009; Benamar, 2015). *Helophorus atlantis* is newly recorded from Rif domain and from Martil basin during our study.

Family HYDROCHIDAE Thomson, 1859
***Hydrochus aljibensis*** Castro & Delgado, 1999
Material examined. **S1:** 7-II-2017 (2 A), 12-V-2018 (1 A).
Chorotype. Endemic Ibero-Maghrebian.
Habitat. This species was found on the banks with vegetation in mid-mountain streams (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco, it is dispersed mainly in the Occidental Rif and in few localities in the Atlas Mountains (Benamar, 2015; Slimani *et al*., 2016). It was only reported in (S1) during our study period in the Martil basin.

***Hydrochus grandicollis*** Kiesenwetter in Heyden, 1870
Material examined. **S2:** 26-VI-2016 (1 A), 19-VI-2017 (2 A).
Chorotype. Atlanto-Mediterranean.
Habitat. Usually found in mid-mountain streams with good conservation status (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. Quite rare in Morocco, the previous records of this element were from the Occidental Rif, the Anti-Atlas and the Eastern Middle Atlas (Bennas, 2002; Benamar *et al*., 2021a). Our collection in Oued Taida (S2) is the first record of this species in the Martil basin and the first recent citation in Morocco after the research conducted by Bennas (2002).

Family HYDROPHILIDAE Latreille, 1802
***Anacaena bipustulata*** (Marsham, 1802)
Material examined. **S2:** 26-VI-2016 (1 A), 27-V-2017 (1 A); **S3:** 20-V-2016 (4 A), 04-I-2018 (7 A); **S5:** 11-III-2017 (1 A), 18-VI-2017 (1 A); **S12:** 04-I-2018 (1 A).
Chorotype. Europeo-Mediterranean.
Habitat. *Anacaena bipustulata* occupies a wide variety of habitats, headwaters, pools and ponds associated with river systems (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. Widespread species in Morocco and has been recorded from several localities mainly in the northwest part (Chavanon *et al*., 2004; Slimani *et al*., 2016; Benamar *et al*., 2021b).

***Anacaena globulus*** (Paykull, 1798)
Material examined. **S1:** 29-IV-2016 (1 A), 27-IV-2017 (1 A); **S2:** 13-III-2016 (2 A), 29-V-2016 (2 A); **S6:** 31-IV-2016 (1 A); **S8:** 29-V-2016 (6 A), 13-V-2018 (1 A); **S9:** 23-IV-2018 (3 A), 29-V-2016 (2 A).
Chorotype. Europeo-Mediterranean.
Habitat. Although it prefers lotic systems, this species can appear in all permanent or semi-permanent water bodies that are not highly disturbed (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco, it has a wide distribution covering the majority of the country's mountainous areas, mostly the Rif domain (Bennas, 2002; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b).

***Anacaena lutescens*** (Stephens, 1829)
Material examined. **S1:** 20-VI-2016 (18 A), 15-VI-2017 (10 A); **S2:** 28-V-2017 (2 A); **S4:** 14-IV-2018 (2 A).
Chorotype. Holarctic.
Habitat. Although it seems to prefer lentic systems, it is also prevalent in river banks (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This species appears in the northwestern side of Morocco and in scattered points in the northeast and the Middle Atlas (Bennas, 2002; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b). It was found only at the upper reaches of Martil basin.

***Berosus affinis*** Brullé, 1835
Material examined. **S19:** 18-V-2018 (2 A).
Chorotype. Atlanto-Mediterranean.
Habitat. This species occupies stagnant or low current waters of both temporary and permanent, soft or mineralized, but usually in shallow ponds (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. Appeared to be common throughout the main geographical domains of Morocco (Bennas, 2002; Chavanon *et al*., 2004; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b). *Berosus affinis* was found only in (S19) located in the downstream of Martil Basin.

***Berosus hispanicus*** Küster, 1847
Material examined. **S3:** 14-XII-2015 (32 A), 13-III-2016 (2 A), 14-XII-2017 (25 A); **S7:** 20-V-2016 (1 A); **S8:** 19-XII-2015 (2 A); **S12:** 17-III-2016 (1 A), 14-XII-2017 (2 A); **S16:** 8-XII-2017 (1 A); **S17:** 18-XII-2015 (2 A); **S18:** 18-XII-2015 (21 A).
Chorotype. W-Palaearctic.
Habitat. *Berosus hispanicus* occupies both lentic and lotic habitats, although it is always associated with areas of low current (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Common throughout the geographical domains of Morocco (Bennas, 2002; Chavanon *et al*., 2004; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b). It was the most abundant species of Hydrophilidae in the Martil basin, which strengthen its presence in the western Rif.

***Hemisphaera guignoti*** Schaefer, 1975
Material examined. **S2:** 26-VI-2016 (1 A); **S4:** 18-VI-2017 (1 A).
Chorotype. W-Mediterranean.
Habitat. This species seems to prefer margins ponds in middle sections of rivers (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco, this species was known from the Rif and a few disperse localities in the Anti-Atlas and the Eastern Middle Atlas (Bennas, 2002; Benamar *et al*., 2021b).

***Enochrus bicolor*** (Fabricius, 1792)
Material examined. **S1:** 15-VI-2017 (1 A).
Chorotype. Palaearctic.
Habitat. This species occupies mineralized waters, often associated to coastal areas (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This species is found in several localities surrounding the country. Moreover it is associated mostly to coastal areas (Chavanon *et al*., 2004; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b). It was only found in Oued Tkaraa (S1) at the scale of Martil basin.

***Helochares lividus*** (Forster, 1771)
Material examined. **S12:** 15-VI-2016 (1 A).
Chorotype. Atlanto-Mediterranean.
Habitat. *H. lividus* occupies both lentic and lotic habitats, although it is always associated with areas of low current (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. Its range in Morocco is mostly wide, covering the majority of the country's geographic areas, especially the northern half (Bennas, 2002; Chavanon *et al*., 2004; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b). Collected only from (S12) in the downstream of Oued Khemis.

***Helochares punctatus*** Sharp, 1869
Material examined. **S1:** 18-III-2016 (18 A), 29-IV-2016 (5 A).
Chorotype. Europeo-Mediterranean.
Habitat. This species occupies oligotrophic pools, but also in peatlands (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco it was recorded from five localities in the Middle Atlas and the Rif (Bennas, 2002; Benamar *et al*., 2021b). Our captures at Oued Tkaraa (S1) constitute the first record of this species for Martil basin and Bouhachem Natural Park.

***Laccobius* (*Dimorpholaccobius*) *atrocephalus atrocephalus*** Reitter, 1872
Material examined. **S2:** 28-V-2017 (1 A); **S8:** 24-VI-2016 (1 A), 18-VI-2017 (1 A); **S9:** 24-VI-2016 (1 A), 18-VI-2017 (1 A); **S13:** 19-VI2016 (2 A), 11-VI-2017 (2 A), 16-V-2018 (1 A); **S14:** 28-V-2017 (1 A); **S15:** 13-V-2018 (1 A); **S16:** 16-VI-2016 (1 A), 13-VI-2017 (1 A); **S19:** 9-III-2017 (1 A).
Chorotype. Afrotropico-Mediterranean.
Habitat. This species occupies pools and ponds associated with small streams with abundant vegetation (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This *Laccobius* was recorded from many scattered localities all over the country, mostly in the northwestern region (Bennas, 2002; Chavanon *et al*., 2004; Slimani *et al*., 2016; Mabrouki *et al*., 2018; Benamar *et al*., 2021b).

***Laccobius* (*Dimorpholaccobius*) *neapolitanus*** Rottenberg, 1874
Material examined. **S4:** 8-XII-2017 (1 A).
Chorotype. W-Mediterranean.
Habitat. This species lives especially on the banks of the headwaters in the middle mountains (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Morocco, it appears mainly in its northern half mostly in the Rif Mountains and some localities from the Atlas mountain (Bennas, 2002; Chavanon *et al*., 2004; Benamar *et al*., 2021b).

***Laccobius* (*Dimorpholaccobius*) *ytenensis*** Sharp, 1910
Material examined. **S13:** 17-III-2016 (1 A).
Chorotype. Europeo-Mediterranean.
Habitat. Species of great ecological plasticity, being able to occupy the banks of both lotic and lentic habitats (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. In Moroccan hydrosystems, this species is frequently encountered in the Rif and the Atlas Mountains (Bennas, 2002; Chavanon *et al*., 2004; Mabrouki *et al*., 2018; Benamar *et al*., 2021b).

Family HYDRAENIDAE Mulsant, 1844
***Hydraena allomorpha*** Fresneda & Lagar, 1991
Material examined. **S1:** 18-III-2016 (2 A), 29-IV-2016 (2 A), 20-VI-2016 (2 A), 27-IV-2017 (1 A), 15-VI-2017 (6 A), 20-XI-2017 (1 A); **S6:** 12-XII-2017 (1 A).
Chorotype. Endemic Ibero-Maghrebian.
Habitat. Typical of mid-mountain freshwater streams (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This species mainly occupies the western and central Rif of Morocco (Bennas *et al*., 2001; Benamar, 2015; Slimani *et al*., 2016).

***Hydraena bisulcata*** Rey, 1884
Material examined. **S1:** 15-VI-2017 (3 A); **S2:** 29-V-2016 (1 A), 23-IV-2018 (2 A); **S3:** 20-V-2016 (1 A); **S4:** 24-V-2017 (1 A); **S5:** 13-III-2016 (1 A), 28-IV-2017 (1 A), 23-V-2018 (1 A).
Chorotype. Endemic Ibero-Maghrebian.
Habitat. Typical of freshwater streams (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This species is cited mostly from the northwest quadrant of Morocco, and from a few localities in central and southern areas of the country (Bennas *et al*., 2001; Benamar, 2015; Slimani *et al*., 2016).

***Hydraena capta*** Orchymont, 1936
Material examined. **S2:** 26-VI-2016 (1 A), 23-IV-2018 (2 A); **S3:** 18-V-2018 (2 A).
Chorotype. Endemic Ibero-Maghrebian.
Habitat. Typical of freshwater streams with a certain flow rate (Millán *et al*., 2014; Benamar, 2015).
Regional distribution. This *Hydraena* has a northern distribution in Morocco, and was mentioned in a few localities in the Atlas Mountains (Bennas *et al*., 2001; Benamar, 2015). Our finding significantly increases its range in the Occidental Rif and the Martil River basin.

***Hydraena cordata*** Schaufuss, 1833
Material examined. **S1:** 14-II-2018 (2 A); **S3:** 04-I-2018 (1 A); **S6:** 15-III-2016 (4 A), 26-VI-2016 (1 A), 11-V-2017 (2 A), 12-XII-2017 (2 A), 25-I-2018 (1 A); **S8:** 24-VI-2016 (3 A); **S17:** 18-XII-2015 (1 A).
Chorotype. W-Mediterranean.
Habitat. This species prefers mainly mountain streams (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Known only from some isolated localities in the Occidental Rif and the Middle Atlas (Bennas *et al*., 2001; Benamar, 2015, Slimani *et al*., 2016). Our findings increases its distribution range in the Martil basin and the Rif region.

***Hydraena rigua*** Orchymont, 1931

Material examined. **S1:** 18-III-2016 (1 A), 29-IV-2016 (2 A), 20-VI-2016 (2 A); **S2:** 26-VI-2016 (1 A), 19-VI-2017 (1 A); **S5:** 8-XII-2017 (4 A); **S6:** 15-III-2016 (1 A), 31-IV-2016 (2 A), 16-VI-2017 (1 A); **S7:** 17-III-2016 (1 A), 27-V-2017 (5 A), 12-XII-2017 (3 A); **S8:** 18-VI-2017 (2 A); **S9:** 13-III-2016 (1 A), 16-V-2017 (2 A), 18-VI-2017 (1 A); **S10:** 22-VI-2016 (2 A), 15-XII-2017 (2 A); **S11:** 22-VI-2016 (1 A); **S12:** 17-III-2016 (2 A), 17-VI-2017 (1 A); **S13:** 17-III-2016 (2 A), 11-VI-2017 (1 A), 14-XII-2017 (2 A); **S16:** 31-IV-2016 (2 A).

Chorotype. Endemic Maghrebian.

Habitat. This species occupies running waters and it could have been captured in lentic habitats (Benamar, 2015).

Regional distribution. Widely distributed in the Rif region including Martil basin, its presence has been detected also in some localities in the central and oriental Plateaux, and in the Atlas domains (Bennas *et al*., 2001; Chavanon *et al*., 2004; Benamar, 2015; Slimani *et al*., 2016; Chakour *et al*., 2017; Mabrouki *et al*., 2018).

***Ochthebius difficilis*** Mulsant, 1844

Material examined. **S11:** 25-V-2017 (1 A).

Chorotype. Holo-Mediterranean.

Habitat. Freshwater streams and rivers with limestone characteristic (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, it is scattered in a few localities through the majority of the country's geographic domains (Bennas *et al*., 2001; Chavanon *et al*., 2004; Benamar, 2015; Mabrouki *et al*., 2018). Our finding in Oued Nakhla (S11) was the first recent citation of this species in the Rif region after the research conducted by Bennas *et al*. (2001), and expands its presence in the Martil basin.

Family ELMIDAE (Latreille, 1798)

***Elmis maugetii velutina*** Reiche, 1879

Material examined. **S2:** 11-III-2017 (2 A); **S6:** 11-XII-2015 (2 A), 31-IV-2016 (28 A), 26-VI-2016 (26 A), 11-V-2017 (3 A), 16-VI-2017 (26 A), 12-XII-2017 (6 A), 25-I-2018 (7 A), 25-I-2018 (6 A); **S19:** 26-V-2017 (2 A).

Chorotype. Endemic Maghrebian.

Habitat. Lotic freshwater systems (Benamar, 2015)

Regional distribution. This species is known from Morocco in the Atlas areas, Oriental region and the Rif in the North of the country (Bennas & Sáinz-Cantero 2007; Benamar, 2015; Taybi *et al*., 2017), where our catches in some scattered localities expand its distribution area in Martil basin.

***Limnius intermedius*** Fairmaire, 1881

Material examined. **S6**: 25-I-2018 (2 A).

Chorotype**.** Europeo-Mediterranean.

Habitat. Mainly in the middle courses of rivers, but also in headwaters (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco this *Limnebius* is recorded in the Rif, in the Middle and High Atlas and in the Oriental plateau (Bennas & Sáinz-Cantero 2007; Chavanon *et al*., 2004; Benamar, 2015).

***Limnius opacus opacus*** Müller, 1806

Material examined. **S10:** 27-I-2018 (2 A).

Chorotype. Europeo-Mediterranean.

Habitat. In lotic habitats, mainly on gravel and sand substrates, but also in mosses in a wide altitudinal range (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This species is spread mainly in isolated areas from the northern, eastern regions to the Middle and High Atlas of Morocco (Bennas & Sáinz-Cantero 2007; Chavanon *et al*., 2004; Benamar, 2015).

***Oulimnius fuscipes*** (Reiche, 1879)

Material examined. **S7:** 27-V-2017 (8 A).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. This species appears in streams of headwaters, generally with great and strong current (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This *Oulimnius* is moderately frequent in the Atlas Mountains, northern and eastern part of Morocco (Chavanon *et al*., 2004; Benamar, 2015; Mabrouki *et al*., 2018). However, our catches in Oued Khemis (S7) will strengthen its presence in Martil basin and the Occidental Rif.

***Oulimnius troglodytes*** (Gyllenhal, 1827)

Material examined. **S1:** 29-IV-2016 (1 A); **S3:** 15-VI-2016 (4 A), 8-III-2017 (80 A), 27-V-2017 (5 A), 11-XII-2017 (3 A), 04-I-2018 (13 A); **S5:** 24-VI-2016 (1 A), 18-II-2018 (2 A); **S6:** 26-VI-2016 (4 A), 16-VI-2017 (5 A), 25-I-2018 (4 A); **S7:** 20-V-2016 (2 A), 15-VI-2016 (1 A), 8-III-2017 (14 A), 14-XII-2017 (14 A); **S8:** 24-VI-2016 (1 A), 11-III-2017 (1 A), 18-VI-2017 (3 A), 15-XII-2017 (39 A), 04-I-2018 (30 A); **S9:** 15-XII-2017 (14 A), 18-II-2018 (4 A); **S11:** 02-II-2018 (1 A); **S12:** 17-III-2016 (2 A), 8-III-2017 (1 A), 27-V-2017 (1 A), 14-XII-2017 (8 A), 04-I-2018 (15 A); **S13:** 11-VI-2017 (1 A), 13-XII-2017 (33 A); **S14:** 8-XII-2017 (2 A), 04-I-2018 (21 A); **S15:** 3-VI-2016 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Both in upstream, middle and downstream, but always in fresh, clean and well oxygenated waters (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, it is known only in Occidental Rif and in a three other sites in the eastern and southern sides of the country (Bennas & Sáinz-Cantero 2007; Chavanon *et al*., 2004; Benamar, 2015; Mabrouki *et al*., 2018). Moreover, this element is the most abundant Elmidae species in the Martil basin, its presence has expanded its range in our region.

***Riolus villosocostatus*** (Reiche, 1879)

Material examined. **S3:** 15-VI-2016 (1 A).

Chorotype. Endemic Maghrebian.

Habitat. This species seems to prefer lenitic systems (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. It is fairly well-known species in various regions through Morocco (Bennas & Sáinz-Cantero 2007; Benamar, 2015). It was reported only at Oued Tkaraa (S1) during this study.

***Stenelmis consobrina consobrina*** Dufour, 1835

Material examined. **S5:** 27-I-2018 (3 A); **S7:** 27-I-2018 (2 A); **S10:** 27-I-2018 (9 A).

Chorotype. Holo-Mediterranean.

Habitat. This species seems to prefer headwaters with thick substrate (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, it is confined to the northwestern, eastern sides and the Middle Atlas (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero 2007; Benamar, 2015; Slimani *et al*., 2016). Known from very scattered localities throughout Marti Basin.

Family DRYOPIDAE Billberg, 1820

***Dryops algiricus*** (Lucas, 1849)

Material examined. **S1:** 18-III-2016 (1 A); **S2:** 26-VI-2016 (1 A), 28-V-2017 (3 A), 19-VI-2017 (1 A), 11-XII-2017 (2 A); **S3:** 15-VI-2016 (1 A), 27-V-2017 (3 A); **S4:** 14-IV-2018 (1 A), 8-XII-2017 (1 A), 14-IV-2018 (1 A); **S5:** 24-VI-2016 (1 A); **S6:** 11-V-2017 (1 A); **S8:** 18-VI-2017 (2 A); **S9:** 18-VI-2017 (1 A); **S13:** 19-VI2016 (1 A).

Chorotype. Holo-Mediterranean.

Habitat. *D. algiricus* lives on the banks of a wide spectrum of habitats, although generally in shallow ponds or lagoons with abundant vegetation (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Widespread species in Morocco mainly in the Rif Mountains and some sites at the Oriental region, Atlas Mountains and near coastal areas (Bennas & Sáinz-Cantero 2007; Benamar, 2015; Slimani *et al*., 2016). Our finding increases its distribution area in the Martil basin and the Occidental Rif.

***Dryops gracilis*** (Karsch, 1881)

Material examined. **S3:** 15-VI-2016 (1 A), 14-XII-2017 (1 A).

Chorotype. Afrotropico-Mediterranean.

Habitat. Appearing mainly on the banks of streams and medium and low sections of rivers (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. This element is mostly reported in the northwest quadrant of Morocco, and some scattered localities at the Atlas Mountains and Oriental region (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero 2007; Benamar, 2015; Mabrouki *et al*., 2018). It was recorded only in the upstream of Oued Khemis (S3) during our study.

***Dryops lutulentus*** (Erichson, 1847)

Material examined. **S1:** 27-IV-2017 (3 A); **S3:** 20-V-2016 (1 A), 8-III-2017 (1 A); **S5:** 28-IV-2017 (1 A); **S7:** 20-V-2016 (1 A); **S8:** 16-V-2017 (2 A).

Chorotype. Turano-Europeo-Mediterranean.

Habitat. Typical species of streams with cold and well-oxygenated waters, where it can be found inhabiting the gravels and sands of the banks (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, this species is known only from the Occidental Rif and two isolated points in the High Atlas and Central Rif (Bennas & Sáinz-Cantero, 2007; Benamar, 2015). Our collection in various localities increases its distribution area in the Martil basin.

***Dryops sulcipennis*** (Costa, 1883)

Material examined. **S6:** 31-IV-2016 (1 A).

Chorotype. Holo-Mediterranean.

Habitat. In lotic habitats, mainly in middle sections of rivers, where it appears in the quietest and backwater areas, between the sand of the banks (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. In Morocco, this species has a northern distribution, in where it has been captured also from scattered points in the Oriental half and Atlas Mountains (Chavanon *et al*., 2004; Bennas & Sáinz-Cantero 2007; Benamar, 2015; Slimani *et al*., 2016; Mabrouki *et al*., 2018). In Martil basin, it is known from Oued Zarka (S6).

***Pomatinus substriatus*** (Müller, 1806)

Material examined. **S6:** 11-V-2017 (1 A), 16-VI-2017 (1 A).

Chorotype. Turano-Europeo-Mediterranean.

Habitat. Typical of medium-sized streams, with cold and well-oxygenated waters. It lives clinging to the lower part of stones and rocks (Millán *et al*., 2014; Benamar, 2015).

Regional distribution. Moroccan records of this species are mostly restricted to the northwest quadrant and a few scattered points in the Atlas Mountains and in Oriental region (Bennas & Sáinz-Cantero 2007; Benamar, 2015; Mabrouki *et al*., 2018).

## HEMIPTERA

Family GERRIDAE Leach, 1815

***Aquarius cinereus*** (Puton, 1869)

Material examined. **S1:** 20-VI-2016 (1 A), 15-VI-2017 (1 A); **S2:** 29-V-2016 (7 A), 26-VI-2016 (7 A), 11-III-2017 (1 A), 28-V-2017 (6 A), 19-VI-2017 (1 A); **S3:** 15-VI-2016 (5 A); **S4:** 16-III-2016 (2 A), 22-VI-2016 (6 A), 24-V-2017 (4 A), 12-VI-2017 (5 A), 14-IV-2018 (3 A); **S5:** 4-IV-2016 (12 A), 24-VI-2016 (27 A), 18-VI-2017 (6 A), 18-II-2018 (2 A), 23-V-2018 (3 A); **S6:** 26-VI-2016 (4 A), 9-III-2017 (1 A), 16-VI-2017 (5 A), 12-XII-2017 (13 A), 18-V-2018 (5 A); **S7:** 20-V-2016 (5 A), 15-VI-2016 (20 A), 17-VI-2017 (2 A); **S8:** 29-V-2016 (16 A), 11-III-2017 (1 A), 16-V-2017 (3 A), 18-VI-2017 (8 A); **S9:** 13-III-2016 (2 A), 24-VI-2016 (2 A), 11-III-2017 (1 A), 16-V-2017 (5 A), 18-VI-2017 (6 A); **S10:** 22-VI-2016 (10 A), 16-V-217 (4 A), 12-VI-2017 (4 A); **S11:** 20-XII-2015 (50 A), 18-VI-2017 (1 A), 15-V-2018 (2 A); **S13:** 20-V-2016 (4 A), 19-VI2016 (10 A), 26-V-2017 (9 A); **S14:** 23-V-2016 (1 A), 19-III-2017 (2 A), 13-V-2018 (4 A); **S15:** 16-VI-2016 (4 A), 12-VI-2017 (3 A)

Chorotype. W-Mediterranean.

Habitat. Surface-dwelling species which prefers running waters (L'Mohdi, 2016).

Regional distribution. The species is mentioned in Morocco in several localities in the north, in some limited sites in the eastern region and in the Atlas Mountains (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018).

***Aquarius najas*** (De Geer, 1773)

Material examined. **S1:** 18-III-2016 (2 A), 20-VI-2016 (3 A), 15-VI-2017 (1 A); **S2:** 13-III-2016 (3 A), 29-V-2016 (12 A), 26-VI-2016 (15 A), 11-III-2017 (2 A), 28-V-2017 (10 A), 19-VI-2017 (2 A), 18-II-2018 (1 A), 23-IV-2018 (1 A); **S3:** 15-VI-2016 (2 A); **S4:** 16-III-2016 (3 A), 22-VI-2016 (10 A), 24-V-2017 (13 A), 12-VI-2017 (7 A), 8-XII-2017 (6 A), 14-IV-2018 (2 A); **S5:** 19-XII-2015 (5 A), 4-IV-2016 (66 A), 24-VI-2016 (40 A), 11-III-2017 (5 A), 18-VI-2017 (20 A), 18-II-2018 (7 A), 23-V-2018 (3 A); **S6:** 31-IV-2016 (13 A), 26-VI-2016 (3 A), 9-III-2017 (1 A), 11-V-2017 (3 A), 16-VI-2017 (15 A), 12-XII-2017 (50 A), 25-I-2018 (15 A), 18-V-2018); **S7:** 20-V-2016 (7 A), 15-VI-2016 (70 A), 27-V-2017 (2 A), 17-VI-2017 (5 A); **S8:** 19-XII-2015 (2 A), 24-VI-2016 (8 A), 16-V-2017 (9 A), 18-VI-2017 (22 A), 13-V-2018 (2 A); **S9:** 29-V-2016 (110 A), 24-VI-2016 (5 A), 11-III-2017 (1 A), 16-V-2017 (8 A), 18-VI-2017 (10 A); **S10:** 22-VI-2016 (10 A), 16-V-2017 (6 A), 12-VI-2017 (13 A), 11-XII-2017 (3 A); **S11:** 20-XII-2015 (13 A); **S12:** 17-VI-2017 (3 A); **S13:** 20-V-2016 (7 A), 19-VI-2016 (15 A), 26-V-2017 (14 A), 11-VI-2017(11 A); **S14:** 23-V-2016 (5 A); **S15:** 16-VI-2016 (4 A), 12-VI-2017 (6 A).

Chorotype. Europeo-Mediterranean.

Habitat. A surface-dwelling species with a wide altitudinal gradient that can tolerate disturbed habitats (Millán *et al*., 1988; L'Mohdi, 2016).

Regional distribution. Generally present in the western Rif but moderately frequent in the Atlas Mountains and eastern part of Morocco (L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018). It is the most common Gerridae taxa in the Martil basin.

***Gerris brasili*** (Poisson, 1941)

Material examined. **S2:** 19-VI-2017 (3 A); **S3:** 15-VI-2016 (3 A), 27-V-2017 (1 A); **S14:** 19-III-2017 (1 A).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. Eurytopic and surface-dwelling species in lotic and lentic habitats (Millán *et al*., 1988; L'Mohdi, 2016).

Regional distribution. Widespread in Morocco, where it is distributed in the Rif, the Middle Atlas and Anti-Atlas and in the eastern part of the country (L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018). This species was reported for the first time in the Martil watershed.

***Gerris gibbifer*** Schummel, 1832

Material examined. **S1:** 20-VI-2016 (5 A), 27-IV-2017 (4 A), 12-V-2018 (2 A); **S3:** 27-V-2017 (1 A); **S9:** 16-V-2017 (1 A); **S13:** 19-VI2016 (1 A); **S14:** 23-V-2016 (2 A); **S18:** 4-VI-2016 (1 A); **S19:** 4-VI-2016 (2 A).

Chorotype. Europeo-Mediterranean.

Habitat. Surface-dwelling species able to occupy temporary and permanent stagnant habitats in the mountain areas (L'Mohdi, 2016).

Regional distribution. Species with a northwestern range in Morocco and has been recorded from scattered sites in the Atlas Mountains, in the central and eastern part of the country (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018). Our finding extends its distribution to the western Rif.

***Gerris thoracicus*** Schummel, 1832

Material examined. **S3:** 17-VI-2017 (1 A); **S7:** 27-V-2017 (2 A); **S9:** 24-VI-2016 (2 A), 16-V-2017 (2 A); **S12:** 20-V-2016 (2 A), 19-VI2016 (1 A), 27-V-2017 (2 A), 17-VI-2017 (1 A); **S13:** 16-V-2018 (4 A); **S14:** 22-VI-2016 (1 A); **S15:** 28-V-2017 (2 A), 12-VI-2017 (1 A); **S18:** 4-VI-2016 (7 A); **S19:** 4-VI-2016 (2 A).

Chorotype. Subcosmopolitan.

Habitat. Surface-dwelling species of rivers, pools and ponds, it can also tolerate brackish habitats and arid areas (Millán *et al*., 1988; L'Mohdi, 2016).

Regional distribution. This species of *Gerris* is the most abundant and common in Morocco, where it has been recorded in several localities in the north, from the plains to the high mountain areas in the central and southern part of the country (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016). Our records have significantly expanded its range in the Martil basin and the western Rif.

Family HEBRIDAE Amyot & Serville, 1843

***Hebrus pusillus*** (Fallén, 1807)

Material examined. **S1:** 12-XI-2015 (1 A), 27-IV-2017 (1 A); **S2:** 26-VI-2016 (1 A); **S7:** 20-V-2016 (1 A).

Chorotype. W-Palaearctic.

Habitat. Typical of stagnant or slow-flowing waters, it is most often found on the banks of aquatic habitats (L'Mohdi, 2016).

Regional distribution. This species has a scattered distribution in several localities throughout the country (Chavanon *et al*., 2004; L'Mohdi, 2016). It was captured for the first time in Martil basin during our research.

Family HYDROMETRIDAE Billberg, 1820

***Hydrometra stagnorum*** (Linnaeus, 1758)

Material examined. **S2:** 13-III-2016 (3 A), 11-III-2017 (2 A), 28-V-2017 (9 A), 19-VI-2017 (7 A), 23-IV-2018 (1 A); **S3:** 27-V-2017 (3 A), 16-V-2018 (2 A); **S4:** 16-III-2016 (6 A), 14-IV-2018 (4 A); **S5:** 24-VI-2016 (1 A), 11-III-2017 (1 A), 23-V-2018 (2 A); **S7:** 17-III-2016 (1 A), 20-V-2016 (1 A), 27-V-2017 (1 A), 16-V-2018 (1 A); **S9:** 18-VI-2017 (1 A); **S10:** 22-VI-2016 (10 A), 14-V-2018 (1 A); **S12:** 20-V-2016 (2 A), 8-III-2017 (2 A); **S15:** 28-V-2017 (1 A), 13-V-2018 (2 A); **S16:** 13-VI-2017 (1 A); **S17:** 26-V-2017 (1 A).

Chorotype. Centralasiatic-European-Mediterranean.

Habitat. Eurytopic species that inhabits the edges of vegetated banks and moves along the surface of slow moving water (L'Mohdi, 2016).

Regional distribution. Common species recorded from several localities in Morocco (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018). It was reported from various sites throughout the Martil basin.

Family MESOVELIIDAE Douglas & Scott, 1867

***Mesovelia vittigera*** Horváth, 1895

Material examined. **S19:** 9-III-2017 (1 A).

Chorotype. Subcosmopolitan.

Habitat. A common species with a wide ecological range, living in both fresh and brackish water, in temporary and permanent running water, as well as in stagnant water (L'Mohdi, 2016).

Regional distribution. Recorded from scattered points in mountainous regions, lowlands and near coastal areas throughout Morocco (L'Mohdi, 2016; Taybi *et al*., 2018). Our finding in the lower course of the Oued Martil (S19) extends its range into the Martil basin and the western Rif.

Family VELIIDAE Brullé, 1836

***Velia ioannis*** Tamanini, 1971

Material examined. **S1:** 29-IV-2016 (6 A), 20-VI-2016 (72 A), 7-II-2017 (1 A), 27-IV-2017 (32 A), 20-XI-2017 (8 A), 14-II-2018 (9 A), 12-V-2018 (12 A); **S2:** 19-XII-2015 (10 A), 13-III-2016 (4 A), 26-VI-2016 (3 A), 11-III-2017 (6 A), 28-V-2017 (10 A), 19-VI-2017 (2 A), 18-II-2018 (2 A), 23-IV-2018 (13 A); **S3:** 17-III-2016 (1 A); **S4:** 14-IV-2018 (1 A); **S6:** 12-XII-2017 (1 A); **S10:** 22-VI-2016 (3 A); **S15:** 13-V-2018 (1 A).

Chorotype. Endemic Maghrebian.

Habitat. Commonly found at the edge of riparian vegetation in stagnant, fresh and brackish water (L'Mohdi, 2016).

Regional distribution. In Morocco, it seems to have a wide distribution, where it has been found in the Western Rif, the High Atlas and the Eastern region (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018).

***Velia noualhieri*** Puton, 1889

Material examined. **S2:** 23-IV-2018 (4 A); **S4:** 14-IV-2018 (1 A); **S7:** 14-XII-2015 (1 A), 8-III-2017 (1 A), 16-V-2018 (2 A); **S12:** 14-XII-2017 (2 A).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. Frequently found in shady, well-preserved streams with dense riparian vegetation (L'Mohdi, 2016).

Regional distribution. Relatively rare in Morocco which previous records of this species are limited to the Rif region and a few sites in the Atlas and eastern region (L'Mohdi, 2016; Taybi *et al*., 2018). Our captures of this species in several localities extend its range in the Martil basin.

Family CORIXIDAE Leach, 1815

***Corixa affinis*** Leach, 1817

Material examined. **S1:** 27-IV-2017 (4 A), 26-V-2017 (2 A); **S3:** 17-III-2016 (5 A); **S17:** 21-V-2018 (1 A).

Chorotype. Palaearctic.

Habitat. This species has been found in relatively deep waters with abundant macrophytes vegetation (Millán *et al*., 1988).

Regional distribution. It may be quite rare in Morocco, found only in some scattered points from the northern, eastern regions, Atlas Mountains and Atlantic coastal areas (Chavanon *et al*., 2004; L'Mohdi, 2016; Taybi *et al*., 2018), and a few localities of Martil basin.

***Micronecta scholtzi*** (Fieber, 1860)

Material examined. **S2:** 28-V-2017 (5 A); **S7:** 17-VI-2017 (2 A); **S11:** 22-VI-2016 (2 A); S1**2:** 8-III-2017 (1 A), 27-V-2017

(1 A), 17-VI-2017 (1 A); **S13:** 11-VI-2017 (1 A); **S14:** 13-XII-2015 (9 A), 23-V-2016 (7 A), 22-VI-2016 (6 A), 28-V-2017 (6 A), 12-VI-2017 (6 A); **S15:** 3-III-2016 (12 A), 3-VI-2016 (7 A), 16-VI-2016 (21 A), 8-III-2017 (6 A), 28-V-2017 (16 A), 12-VI-2017 (35); **S16:** 18-XII-2015 (20 A), 3-VI-2016 (12 A), 16-VI-2016 (69 A), 28-V-2017 (6 A), 13-VI-2017 (3 A); **S17:** 4-VI-2016 (8 A), 19-VI-2016 (21 A), 26-V-2017 (17 A), 16-V-2017 (15 A); **S18:** 18-XII-2015 (23 A), 4-VI-2016 (20 A), 26-V-2017 (4 A); **S19:** 18-XII-2015 (2 A), 19-VI-2016 (58 A).

Chorotype. Europeo-Mediterranean.

Habitat. This species can occupy the banks of lotic as well as lentic habitats with sandy or stony substrates (L'Mohdi, 2016).

Regional distribution. Common species throughout the northern half of Morocco (Chavanon *et al*., 2004; L'Mohdi, 2016; Taybi *et al*., 2018). Our captures in many localities in the Martil Basin support the distribution of this species in the Western Rif.

***Parasigara rivularis*** Baena, 1997

Material examined. **S1:** 15-VI-2017 (8 A); **S2:** 19-XII-2015 (2 A), 28-V-2017 (2 A), 19-VI-2017 (9 A), 11-XII-2017 (1 A); **S3:** 14-XII-2015 (19 A), 17-III-2016 (17 A), 20-V-2016 (5 A), 15-VI-2016 (20 A), 8-III-2017 (1 A), 27-V-2017 (4 A), 17-VI-2017 (20 A), 14-XII-2017 (6 A); **S5:** 19-XII-2015 (5 A), 28-IV-2017 (5 A), 18-VI-2017 (2 A), 15-XII-2017 (1 A); **S6:** 26-VI-2016 (5 A), 16-VI-2017 (6 A), 18-V-2018 (1 A); **S7:** 27-V-2017 (4 A); **S8:** 19-XII-2015 (25 A), 29-V-2016 (8 A), 18-VI-2017 (1 A); **S9:** 18-VI-2017 (1 A); **S10:** 16-V-2017 (2 A); **S12:** 16-V-2018 (3 A).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. Typical of running waters flowing over a substrate with a moderate granulometry, consisting mainly of gravel, pebbles and boulders (L'Mohdi, 2016).

Regional distribution. Endemic to Morocco and Spain. This species is only known from isolated localities in the western and central Rif and in the High Atlas. Our captures in the Martil basin constitute the first known northernmost citation for this species in Morocco.

***Parasigara transversa*** (Fieber, 1848)

Material examined. **S1:** 18-III-2016 (8 A), 29-IV-2016 (2 A), 20-VI-2016 (1 A), 15-VI-2017 (2 A); **S2:** 19-XII-2015 (28 A), 26-VI-2016 (17 A), 19-VI-2017 (2 A); **S3:** 14-XII-2015 (30 A), 17-III-2016 (10 A), 15-VI-2016 (11 A), 17-VI-2017 (17 A), 16-V-2018 (4 A); **S4:** 12-VI-2017 (1 A); **S5:** 24-VI-2016 (2 A); **S6:** 26-VI-2016 (2 A); **S7:** 20-V-2016 (1 A), 8-III-2017 (1 A), 14-XII-2017 (2 A), 04-I-2018 (1 A); **S8:** 13-III-2016 (1 A), 29-V-2016 (4 A), 13-V-2018 (8 A); **S9:** 19-XII-2015 (4 A), 13-III-2016 (1 A); **S10:** 22-VI-2016 (3 A); **S12:** 15-VI-2016 (3 A).

Chorotype. Endemic Ibero-Maghrebian.

Habitat. Prefers lotic waters with aquatic plants but it can be also found in lentic waters (L'Mohdi, 2016).

Regional distribution. This species has been found in the Rif region and in a few scattered sites from some lowlands of the Central Plateau and also in the Atlas Mountains (L'Mohdi, 2016; Slimani *et al*., 2016). Its capture in several localities in the Martil basin supports its wide distribution in the western Rif.

***Sigara lateralis*** (Leach, 1817)

Material examined. **S6:** 31-IV-2016 (8 A); **S7:** 14-XII-2015 (36 A); **S12:** 20-V-2016 (12 A); **S13**: 20-V-2016 (1 A); **S14:** 23-V-2016 (6 A); **S15:** 3-VI-2016 (5 A); **S16:** 18-XII-2015 (30 A); **S17:** 18-XII-2015 (64 A), 3-III-2016 (1 A); **S18:** 18-XII-2015 (20 A), 3-III-2016 (2 A), 4-VI-2016 (5 A); **S19:** 18-XII-2015 (10 A), 4-VI-2016 (8 A); **S20**: 19-VI-2016 (1 A), 13-V-2017 (5 A), 21-V-2018 (12 A).

Chorotype. Subcosmopolitan.

Habitat. Species of great ecological plasticity, it appears in various types of habitats, freshwater, brackish of plains or mountains (L'Mohdi, 2016).

Regional distribution. *Sigara lateralis* is considered the most frequently encountered species of *Sigara* in Morocco, where it inhabits the majority of its biogeographical areas (Chavanon *et al*., 2004; L'Mohdi, 2016; Taybi *et al*., 2018). Our records significantly increased the range of this species in the Northern Morocco.

***Trichocorixa verticalis verticalis*** (Fieber, 1851)

Material examined. **S6:** 11-V-2017 (3 A); **S19:** 19-XII-2015 (1 A).

Chorotype. Subcosmopolitan.

Habitat. Prefers saline or brackish water and is generally found in lowland streams and coastal hydrosystems (L'Mohdi, 2016).

Regional distribution. Exotic species, native to the Atlantic coast of the Nearctic. The first citation of this element for Morocco was given from some sites on the northern Atlantic and Mediterranean coast by L'Mohdi. *et al.* (2010). However, this invasive species was recently quoted along the eastern Mediterranean coast of Morocco (Taybi *et al*., 2018, 2020). Our finding of this species at Oued Zarka (S6) and Coelma (S19) supports its distribution in the Martil basin and the western Rif.

Family NAUCORIDAE Leach, 1815

***Naucoris maculatus*** Fabricius, 1798

Material examined. **S1:** 18-III-2016 (1 A), 12-V-2018 (1 A); **S12:** 20-V-2016 (1 A), 15-VI-2016 (5 A); **S18:** 18-XII-2015 (4 A).

Chorotype. Atlanto-Mediterranean.

Habitat. This species is found in lotic or lentic aquatic ecosystems and appears to be more dependent on vegetated aquatic habitats (L'Mohdi, 2016).

Regional distribution. In Morocco, in addition to the Atlantic and Mediterranean coastlines, it is mentioned also in the Rif, Atlas Mountains and eastern region (Chavanon *et al*., 2004; L'Mohdi, 2016; Taybi *et al*., 2018). Our results enable to extend its distribution to the western Rif.

Family NEPIDAE Latreille, 1802

***Nepa cinerea*** (Linnaeus, 1758)

Material examined. **S1:** 20-VI-2016 (3 A), 27-IV-2017 (3 A), 15-VI-2017 (1 A), 12-V-2018 (8 A); **S2:** 28-V-2017 (4 A), 23-IV-2018 (8 A); **S3:** 27-V-2017 (1 A); **S5:** 28-IV-2017 (1 A); **S15:** 13-V-2018 (1 A).

Chorotype. Palaearctic.

Habitat. Adapted to different types of habitats such as puddles, swamps and freshwater with a high altitudinal gradient (L'Mohdi, 2016).

Regional distribution. This species covers the major biogeographical domains of Morocco (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018).

Family NOTONECTIDAE Latreille, 1802

***Anisops sardeus*** Henrrich-Schaeffer, 1849

Material examined. **S3:** 17-III-2016 (2 A), 20-V-2016 (4 A), 17-VI-2017 (3 A); **S11:** 25-V-2017 (1 A), 15-V-2018 (26 A); **S12:** 16-V-2018 (3 A); **S15:** 28-V-2017 (1 A), 13-V-2018 (2 A); **S16:** 18-XII-2015 (3 A), 3-VI-2016 (1 A), 16-VI-2016 (3 A), 8-XII-2017 (1 A), 06-I-2018 (2 A); **S17:** 21-V-2018 (1 A); **S18:** 18-XII-2015 (8 A), 19-VI2016 (61 A), 19-XI-2017 (1 A); **S19:** 18-XII-2015 (9 A), 4-VI-2016 (3 A), 19-VI2016 (92 A), 26-V-2017 (37 A), 18-V-2018 (6 A).

Chorotype. Subcosmopolitan.

Habitat. Eurytopic species that prefers the slow currents of rivers but can also tolerate brackish habitats (L'Mohdi, 2016).

Regional distribution. *Anisops sardeus* is reported in different geographic domains of the country from coastal regions, lowlands to high mountain areas (L'Mohdi, 2016), and recently at the Moulouya watershed in eastern side (Taybi *et al*., 2018). Our catches in different sites in the downstream part of the basin allow to extend its range in the western Rif.

***Notonecta glauca glauca*** Linnaeus, 1758

Material examined. **S3:** 15-VI-2016 (1 A).

Chorotype. W-Palaearctic.

Habitat. Ubiquitous species, it can be found in lotic or lentic freshwater systems (L'Mohdi, 2016).

Regional distribution. Quite rare in Morocco, the previous records of this species occured in a few sites in the Rif and Middle Atlas (L'Mohdi, 2016; Slimani *et al*., 2016). Recently, it was recorded from the Moulouya watershed in the eastern region (Taybi *et al*., 2018). Our capture of this species in Oued Khemis (S3) was the first record in the Martil basin.

***Notonecta maculata*** Fabricius, 1794

Material examined. **S1:** 12-XI-2015 (4 A), 18-III-2016 (3 A), 29-IV-2016 (4 A), 7-II-2017 (2 A), 27-IV-2017 (4 A), 15-VI-2017 (10 A), 20-XI-2017 (1 A), 14-II-2018 (3 A), 12-V-2018 (3 A); **S2:** 19-XII-2015 (8 A), 13-III-2016 (1 A), 29-V-2016 (8 A), 28-V-2017 (24 A), 19-VI-2017 (19 A), 23-IV-2018 (4 A); **S3:** 17-III-2016 (4 A), 20-V-2016 (12 A), 27-V-2017 (9 A), 17-VI-2017 (10 A), 14-XII-2017 (1 A), 04-I-2018 (1 A), 16-V-2018 (8 A); **S4:** 27-V-2016 (1 A), 24-V-2017 (16 A); **S5:** 4-IV-2016 (19 A), 11-III-2017 (3 A), 18-VI-2017 (5 A), 23-V-2018 (10 A); **S6:** 31-IV-2016 (15 A), 16-VI-2017 (3 A), 18-V-2018 (24 A); **S7:** 27-V-2017 (4 A), 17-VI-2017 (4 A); **S8:** 13-III-2016 (1 A), 29-V-2016 (35), 11-III-2017 (1 A), 16-V-2017 (9 A), 18-VI-2017 (5 A), 13-V-2018 (27 A); **S9:** 16-V-2017 (4 A), 18-VI-2017 (3 A), 23-IV-2018 (6 A); **S11:** 15-V-2018 (5 A); **S12:** 27-V-2017 (7 A), 16-V-2018 (2 A); **S14:** 28-V-2017 (1 A).

Chorotype. Atlanto-Mediterranean.

Habitat. Widespread and resistant to pollutants, it is able to colonise different types of permanent and temporary (L'Mohdi, 2016).

Regional distribution. In Morocco, this species is the most abundant and frequent Notonectidae, especially in the north part of the country (L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018).

***Notonecta meridionalis*** Poisson, 1926

Material examined. **S1:** 12-XI-2015 (2 A), 29-IV-2016 (2 A), 20-VI-2016 (8 A), 27-IV-2017 (2 A), 15-VI-2017 (11 A).

Chorotype. Turano-Europeo-Mediterranean.

Habitat. This species is qualified as migratory species; it can be found in lotic or lentic freshwater systems (L'Mohdi, 2016).

Regional distribution. Distributed in several localities in the coastal regions, plains and mountains in the northern half of Morocco (Chavanon *et al*., 2004; L'Mohdi, 2016; Slimani *et al*., 2016; Taybi *et al*., 2018).

***Notonecta obliqua*** Thunberg, 1787

Material examined. **S2:** 28-V-2017 (2 A), 19-VI-2017 (16 A).

Chorotype. Turano-Europeo-Mediterranean.

Habitat. This species inhabits mainly lentic and slightly brackish, temporary and permanent aquatic habitats at high and medium altitudes (L'Mohdi, 2016).

Regional distribution. Very rare species in Morocco, encountered in some limited areas in the Rif, Atlas Mountains and central coastal lowlands (L'Mohdi, 2016; Slimani *et al*., 2016). Our samples at Oued Taida (S2) constitute the first record for the Martil basin.

Family PLEIDAE Fieber, 1851

***Plea minutissima*** (Leach, 1818)

Material examined. **S1:** 18-III-2016 (3 A); **S12:** 20-V-2016 (1 A); **S18:** 18-XII-2015 (2 A), 19-VI2016 (2 A); **S19:** 18-XII-2015 (10 A), 19-VI2016 (3 A), 26-V-2017 (1 A).

Chorotype**.** Centralasiatic-Europeo-Mediterranean.

Habitat. Typical of fresh and brackish waters, usually stagnant with riparian vegetation (L'Mohdi, 2016).

Regional distribution. This species is common in Morocco; it has been captured in various geographical areas of the country (Chavanon *et al*., 2004; L'Mohdi, 2016; Taybi *et al*., 2018). Our catches in the Martil basin have extended its distribution area to the north of the country.

## Discussion

The considerable temporal environmental fluctuations in the Martil basin, such as seasonality and flow regime, cause changes on benthic fauna composition and structure, leading to variations in aquatic species assemblages, following what was observed in other Mediterranean regions (Tonkin *et al*., 2017).

In the Martil basin, OCH richness (102 species) is lower than that recorded in the Laou basin (930 km$^2$, 141 species) (Bennas *et al*., 2009), and greater than that captured in Upper Loukkos (1370 km$^2$, 80 species) (Slimani, 2018). Indeed, specific richness was higher in permanent streams showing a certain degree of stability compared to intermittent ones mostly during summer. This result is similar to what is known in other regions of Mediterranean areas (Bêche *et al*., 2006; Bonada *et al*., 2007; García-Roger *et al*., 2011; Giam *et al*., 2017), except for downstream perennial stations which were influenced by the concentration of pollutants, anthropogenic disturbances and Martil River rehabilitation project. These factors affect the ecological status of the aforementioned aquatic ecosystems creating as a result favorable conditions for the establishment of alien species such as *Trichocorixa verticalis verticalis,* which was dispersed recently in our study area and expanded its distribution range in the northern and eastern regions of the country (L'Mohdi *et al*., 2010; Taybi *et al*., 2020).

Furthermore, species richness is significantly related to the large variation in seasonal flow intermittency hydrosystems (Bêche *et al*., 2006), in which some species have been successfully adapted to the strong seasonal fluctuations of the Mediterranean watercourses, and have certainly developed strategies to face or escape drought stress, mainly those occupying intermittent streams (Cid *et al*., 2017). However, many species in our case such as *Aulonogyrus striatus*, *Aquarius cinereus*, *Aquarius najas*, *Velia ioannis*, *Parasigara rivularis* and *Sigara lateralis* were recorded regularly over all seasons in the study area.

Concomitantly, periods of low flow could lead to the loss of habitats with high flows and thus increase a patchy mosaic of pools that impose new environmental

filters for aquatic communities providing refuge for typical pool species as drought occurs, thus allowing species with high adaptive and/or dispersal capacity to persist in periods of drought (García-Roger *et al*., 2011; Cid *et al*., 2017). Significant differences are observed between localities according to their hydrological features. Nonetheless, forty species seem to be common in all stream types, fifty-one were presented in only perennial streams, whereas eleven species were associated only with the intermittent and/or ephemeral sections of the Martil basin.

In contrast, the rewetting periods and the increase in flow during rainy periods has a significant influence on sediment load and streambed structure of the river, imposing new constraints and challenges for lentic species and, conversely, promoting the re-colonization of riffle ones, which are relatively adapted to high flows or/and low temperature (Cid *et al*., 2017). However, many species in our case such as *Lestes viridis*, *Gyrinus caspius*, *Noterus laevis*, *Graptodytes ignotus*, *Nebrioporus clarkii*, *Hydraena bisulcata*, *Hydraena cordata*, *Dryops algiricus*, *Hebrus pusillus*, *Nepa cinerea* and *Plea minutissima* in which they appear within the wet and dry periods in perennial sites and only during wet periods at the intermittent and/or ephemeral sites.

The most interesting faunitic findings consist in the first citation for the whole Rif region of *Helophorus atlantis*, the first record at the Occidental Rif and the second one at the scale of Morocco of *Hydroporus memnonius* signalled by Bennas & Sáinz-Cantero (2006) and *Hydroporus rifensis*, the new endemic species recently described from Central Rif mountains by Manuel (2014) at the same region. In addition, many species, like *Zygonyx torridus*, *Peltodytes caesus*, *Agabus conspersus*, *Deronectes theryi*, *Hydrochus grandicollis*, *Helochares punctatus*, *Gerris brasili*, *Hebrus pusillus*, *Parasigara rivularis* and *Notonecta obliqua* were newly mentioned for the Martil River Basin.

The analysis of the aquatic OCH species composition of the Martil basin, based on the chorological categories assigned to each taxon, shows that they consist essentially of Mediterranean species (52 %), followed by Palaearctic elements (31 %), and lastly, the elements with wide distribution (17 %). Within the Mediterranean elements, the W-Mediterranean, Atlanto-Mediterranean and Holo-Mediterranean chorotypes show 31%, 18 % and 16 % respectively.

In terms of endemism, the Mediterranean endemic species in the broadest sense showed a clear dominance of the Ibero-Maghrebian elements (53 %), followed by the Maghrebain ones (31 %) and 16 % for the Moroccan chorotype. Indeed, *Deronectes theryi*, *Hydroporus rifensis* and *Helophorus atlantis* are strictly Moroccan endemic species, where one of them is endemic only to the Rif region. The dominance of Ibero-Maghrebian chorotype has also been reported in other researches on OCH species studied in the Rif region (Bennas *et al*., 2001; Bennas & Sáinz-Cantero, 2006, 2007; El Haissoufi *et al*., 2008; L'Mohdi *et al*., 2008; Benamar *et al*., 2011; Slimani *et al*., 2016), whereas in Eastern Morocco, Algeria and Tunisia, the Maghrebian Chorotype was the most dominant (Touaylia *et al*., 2011; Taybi *et al*., 2017, 2019; Touaylia, 2017; Bennas *et al*., 2018; Lamine *et al*., 2019) (Fig. 4).

This situation is explained by the paleogeographic events having marked the history of the Mediterranean region through the Betic-Riffean massif, which functioned as a land bridge permitting faunal exchanges between these two neighboring zones (Lavergne *et al*., 2012; Touaylia, 2017) and the geographical position of Martil watershed within the Intercontinental Biosphere Reserve of the Mediterranean, which also includes the northern part of the Bouhachem Natural Park, this clearly proves that our study area has been recognized as an area of high biodiversity and endemicity.

As well as the fact that the north of Morocco is a very important transition zone between Africa and Europe where species of several origin meet, its high level of landscape mosaic clearly proves the unique character of this region as an important biodiversity area in the Mediterranean region, which is inhabited by various endemic species (Jaskula, 2015).

Therefore, identifying vulnerable species and degraded habitats along with must be taken into account to adequately protect aquatic biodiversity considering the rate of species extinction associated with high degree of anthropogenic pressures and levels of drought in the Rif region (Bennas *et al*., 2007, 2008, 2009).

Hence, because of the narrow-range and strict ecological requirements of some endemic species, evaluating the impact of climate warming and rapid changes in land use on biodiversity presents major challenges to conservation biology, forcing us to provide the necessary tools to preserve this Moroccan natural heritage (Sánchez-Fernández *et al*., 2008; Heller & Zavaleta, 2009; Arribas *et al*., 2015).

## Acknowledgements

Thanks are due to anonymous reviewers for their constructive comments and valuable corrections on the manuscript. We would like to thank the Laboratory of Ecology, Systematics and Conservation of the Biodiversity and the Faculty of Sciences Abdelmalek Essaadi University for the healthful working conditions to carry out this study.

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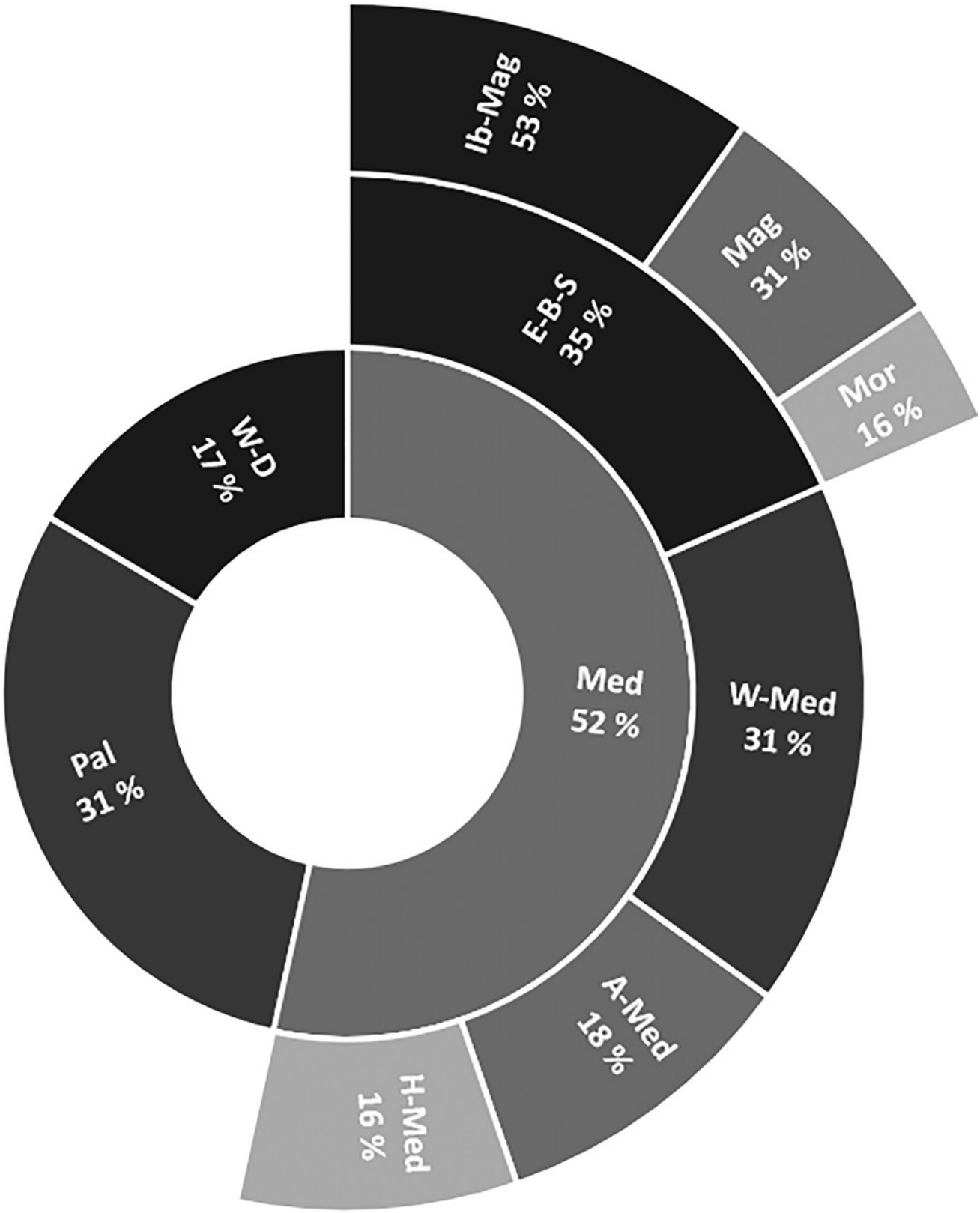


Fig. 4.— The main chorological categories of the investigated species in the Martil Basin. Abbreviations: A-Med: Atlanto-Mediterranean; E-B-S: Endemic in the broadest sense; H-Med: Holo-Mediterranean; Ib-Mag: Ibero-Maghrebian; Mag: Maghrebian; Med: Mediterranean; Mo: Moroccan; Pal: Palaearctic; W-D: Wide distribution; W-Med: W-Mediterranean.

Fig. 4.— Principales categorías corológicas de las especies de OCH en la Cuenca del río Martil. Abreviaturas: A-Med: Atlanto-Mediterránea; E-B-S: Endémica en el sentido amplio; H-Med: Holo-Mediterránea; Ib-Mag: Ibero-Magrebí; Mag: Magrebí; Med: Mediterránea; Mo: Marroquí; Pal: Paleártica; W-D: Amplia distribución; W-Med: W-Mediterránea.

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