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Bio-ecological relationship on Diptera's order among invertebrates of Reghaia Lake (Algeria)

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ABSTRACT

Background: The present study is carried out during year 2009 to identify Arthropods species, essentially Diptera. Used methods for sampling are those of yellow plates, sweep net and larvae's harvest on period of July to September 2009 at the Swamp of Reghaîa. Whose it is considered as a protected area of international importance, it is listed as a Ramsar Site in 2003. It is gathering in fact favourable conditions in settlement and multiplication of terrestrial and aquatic insects for nesting and hibernation of migratory birds and to maintaining wild mammals. As result to this remarkable diversity. **Objective:** It is underlined that not much works have been conducted on richness of Diptera order among Entomofauna settling humid ecosystems such as the natural reserve of Reghaîa in Algeria. So, the choice of the present work is made in view of Diptera species importance within present arthropod fauna at level of Reghaîa Lake. Their identification and study of their bio ecology are essential, on the one hand to guide and to refine preventive fight method such as surveillance of larval habitats of pathogenic vectors agent's species and on the other hand to maintain presence of species contributing to ecology balance in wetlands. **Results:** On the edges of the Reghaia swamp 111 species are noted in yellow plates with 31 Diptera 'speciesand or the higher rate is made by Homoptera with 68,5 %, Hymenoptera with 12.8% followed by Diptera with 12.4%. In the bush overhanging swamp of Reghaia, 198 arthropods species where Diptera order appears the most important with 113 individuals, thus (57,1%) and along the waterfront 55 arthropods species with a dominance of Diptera order (55.0%) in the sweep net. The harvesting method of larvae allowed capture of 5 species of Culicidae (*Culex periguiguus*, *Culex impudicus*, *Culex mimeticus* et *Uranotaenia unguicula*, *Anopheles labranchiae*), These latter make order of Diptera the most dominant in the Lake's water with (75.0%) by comparing presence of other insects species in the water such as larvae of Zygoptera *Coenagrion* sp., of Anisoptera Libellulidae, imagos of Naucoridae (*Naucoris* sp.), larvae of different stage of Dytiscidae and larvae of Plecoptera. **Conclusion:** Diptera form a very important order among invertebrates of Reghaia's natural reserve, this ranking is justified by the high individual's number captured in a short period. Notably the capture of five species of Culicidae which trapping of *Phlebotomus* sp. may create serious concern. The combination of the three methods of trapping proving their efficiency of capture invertebrate mostly Diptera. In addition, it helps to investigate as precisely as possible the entomological diversity of a site with different environments.

KEYWORDS: Diptera Swamp of Reghaîa Coloured traps Ssweep net Larvae harvesting.

INTRODUCTION

Diptera are a group of very recent insects and they conquered a wide variety of habitats and ecological niches [29]. According [34], Diptera are many are attributed to 90% or more of the winged insect fauna in the most different wild and amenage habitats. Similarly [63] reports that the Diptera are a great people, both the number of species than that of individuals. The importance of this order directs the choice of the topic of this work; wiche is the determination of the position of mosquitoes and flies between invertebrates Lake Reghaia. This choice is made due to problems caused by several Diptera species first of all over animal and human health and likewise on cultivated crops. Some mosquitoes as vectors can transmit viruses, bacteria, protozoan and helminth [21,28,33]. [4] montion that Mosquitoes particularly species belonging to Aedes, Culex and Anopheles play an important role in global disease transmission. The diseases that they transmit impact directly on the human and animal health. [42, 41, 66] pointing to the biting midges of the genus Culicoides (Diptera: Ceratopogonidae) which are biological vectors of numerous pathogens, including viruses bluetongue In fact the Arbovirus bluetongue is responsible for a serious deadly infection for wild and domestic ruminants such as sheep. In fact, Catarrhal Arbovirus fever or Blue Tongue is responsible of a serious and fatal infection for wild and domestic ruminant such as sheep [51, 67]. [14] draw attention to emergence of West Nile Virus was recently recorded in several European countries, which can lead tosevere health problems in horse populations. Europe is also at risk of introduction of mosquito-borneequine alphavirus from Americas [14]. In this connection, it should be remembered harms provoked in cultivated plots by Cecidomyiidae such as Mayetiola destructor Say. They provoke yield reduction at harvest time in important proportions. Many species of Cecidomyiidae induce foliar diseases and appearance of galls. Furthermore, maggots of some Tipulidae species destroy roots of various Grasses such as corn and so seeds and grains in germination state [38]. Thus by its leafminer larvae leaves, stems, cambium, roots, seeds or flowering heads the family Agromyzidae is, with that of Tephritidae, one of the most important to agriculture by the damage it causes. We know about 2900 species of Diptera Agromyzidae, approximately 7% of agronomic interest [26]. It should be noted that Diptera are not always harmful. Some species are useful in the environment. This is the case of Diptera saprophagous, coprophagous et nécrophagous. [63] according all vegetable or animal products in fermentation or decomposing like rotten fruit, manure, carrion attract many Diptera who come to feed or deposit their egg laying. this is the case of most of the larvae of Diptera living in rotting organic matter such as sarcophagous, so many families, like coprophagous with Muscidae and Stratiomyidae or even like of necrophagous such as Calliphoridae and some Sarcophagidae according to [23]. [30] specifies that the stable fly, Stomoxys calcitrans L. is a pest of livestock as adults males and females feed on blood herbivorous animals such as cattle and horses remain its preferred hosts, but females Stomoxys exploit a variety of decaying organic materials for laying eggs. They also play an important role in the renewal of soil organic matter by restating include forest litter, they help transform [38]. They play a big role in the process of decomposition of animal matter [64]. [15] reports when an animal dies, it attracts several species of invertebrates and insects, which will feed on its carcass. The first scavenger species that arrive on a carcass belong to the order of Diptera. Other Nematocera species involve in ecological balance stability as larvae of some Chironomidae's species which are a part of more 10 % of fish and amphibia foods in lakes and in swamps [25] (FONTAINE et al., 1976). [12] note Diptera as the third class with 9.8% of insects consumed by Phylloscopus collybita living at Lac Tonga (Noth East of Algeria). Diptera are the second most consumed group by the chicks and the most consumed prey during August in northeastern Algeria [53]. The scientific interest involved in the choice of this work that considers the medical-veterinary importance, agricultural, scavenging, economic and ecological of Diptera order in the nature reserve of Reghaia.

MATERIAL AND METHODS

The structure of this part comprises notably presentation of the study region and the adapted methodology on the ground and in laboratory. Lake of Reghaîa is located on Mediterranean Coastline at about 30 km East of Algiers City (36° 45' à 36° 48' N., 3° 19' à 3° 21' E.) (Fig. 1). It is limited on West by agricultural lands of former Sentouli brothers'domain. back country of Ain-Taya, in the south by Eastern plain of Mitidja, on the East by coastal dunes of Boudouaou BahrI, and in the North by Mediterranean Sea. This site is classified Ramsar Site on 2003 covering approximately 1500 ha with a half is marine. Bioclimatic stage is sub-humid with temperate winter. The amount of precipitation of the study year 2009 reaches 636.4 mm. Considering the remarkable density at level of the swamp, it seems to be imperative to choose three sampling points.

The first one is located on the edge of the water body in front of the Hunting Centre Building, intended for installation of coloured traps and the implementation of mowing with help of sweep net. The second sampling point is located at some meters upper the previous one and far of water edge by 30 m. It is here that sampling with help of sweep net will be also done. The third one corresponds to pastures in place in the South-West of the Reghaia Lake which presents nine water-pools where precisely harvests of Diptera's larvae are low. In order to be able to harvest the maximum of individuals from point of view qualitative and quantitative in experiment

stations, it is used three sampling techniques, those ones of yellow plates, of sweep nets and aquatic larvae harvest.

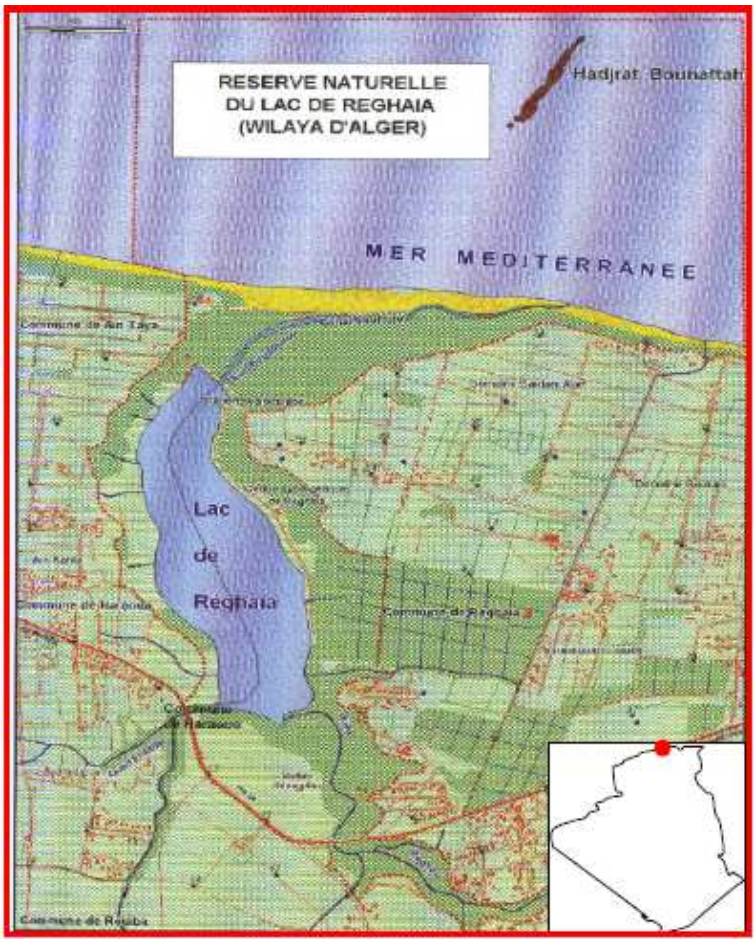

Fig. 1: General map of the Nature Reserve of Lake Réghaïa [61]

According to [32], the coloured traps present a double attractiveness having regard on the one hand to their colour and on the other hand to the water presence, vital element for insects and the major part of species are actively looking for. They make a strong contribution to better know the entomological settlement of a region [6]. This type of trap is particularly simple and cheap; allow capturing a great variety of Diptera [38]. The latter author states that it is more efficient and that the yellow seems to be the best colour to attract a multitude of insects [38]. Consequently, in the present study 8 yellow traps are installed on the ground at 3 m intervals. They are let in place during 24 hours. They are put in place between January and August 2010, between 13 and 18 of each month. Each of these traps is full of half water height. As wetting agent, a pinch of detergent is used in each trap. Then 24 hours later, the content of each container is collected. Mowing with help of sweep net is a technique of counting by interception and by effort unit. It is composed of strong pocket made of a heavy canvas with depth of about 50 cm; a bottom is slightly rounded. Its edges are doubling hemmed before to be threaded on a robust circle made of round iron with a section of 3 / 4 mm. This metallic circle is fixed on a wooden handle 1 m long; technique of mowing which is made at random. It consists to mow on the whole height of herbaceous vegetation, by scraping the ground. In the framework of this study, 3 repetitions of 10 blows each one is made in the middle of each of the three months July, August and September, which are between 13 and 17 of each month. After completion of ten blows, pocket is treated with insecticide to prevent flight and leakage of samples.

The trapped invertebrates in the net are gathered with care to prevent their deterioration. A first sorting is made on the ground to eliminate twigs and leaves fragments which are hung to the canvas. Samples are then put in plastic bags bearing sample number and so date and location indications.

The capture of aquatic larvae is made with help of a cloudy-water net [35]. In the present case, a small plastic jerry can of 2 litres capacity is used, tied to a string on the top of a handle of 2 m long. After filtration of sampled water in a container through two colanders of different mesh and size, larvae are then recovered, stored in plastic tubes on-half full of alcohol at 70%. Each tube bears a small tag with all indications linked to dates

and captures locations written with a lead HB pencil. Larvae habitats must always be approached carefully to prevent insects' escape. As a matter of fact, operator should face the sun to avoid disturbance of the insects due to the shade or water movement, most of them go to move towards deep water and to hide from the operator sight In laboratory, the used techniques consist in two steps which are preparation and larvae mounting or determination in laboratory of species gathered on the ground, This identification is made on the base of guides and dichotomous keys particularly those of [54, 55, 56, 57, 58], of [49], of [27], of [22] of [52], of [43,45, 46,47,48], of [65], of [38, 39]. and of [3]. This is confirmed by Professor Doumandji Salaheddine. The identified species are classified and schematically represented.

The mounting technique of genitalia and aquatic larvae comprises several steps [38]. The first one is a potashing (Fig. 2). It consists to put insect or part of the Arthropod's body to be studied in a Beaker of 100 ml volume containing an aqueous potash solution at 10% (KOH). A small incision is made laterally on the insect's body to promote penetration of potash. This first operation focuses to elimination of non sclerotised organ such as digestive tract, genital organ and greasy substance. So, content of Beaker is put to boiling during 10 min. The second step seeks to eliminate traces of potash found in the sample. For this purpose, in a watch glass containing distilled water, peace is placed during 10 min. The sample may be put directly in a watch glass containing ethanol at 70%. The third step is initiated since this one focuses dehydration of the piece. Another bath containing alcohol at 100% is essential.

The fourth step is an impregnation during 1 second only in a watch glass filled of toluene. Inclusion is the fifth step; the mounting of different parts of the Diptera's body such as wings is made in drop of Faure liquid between blade and lamella, all that remains is to mention on the blade side the species 'name, location and date. Mounting of larvae is based on those of the fourth step. They are recovered for mounting between blade and lamella. With help of a fine needle, larva's head is cut and so its abdominal end from the seventh segment. Mounting is made as previously mentioned. Identification is done by observing details of insect's morphology with help of photonic microscopy. Indications on the species 'name date and harvest location are mentioned on the blade (Fig. 2).

Results obtained are exploited by two ecological indices which are as follows: Total richness (S) which is the total Diptera species number regarding settlement considered in coloured traps and bright traps in an ecosystem [50]. Relative abundance or relative frequency is expressed in percentage. This is the report established between a number of species and the total individual's number of all species involved [24]. In the present study stations each sampled species is represented by proportion of its numbers compared to those of all species taken together into consideration.

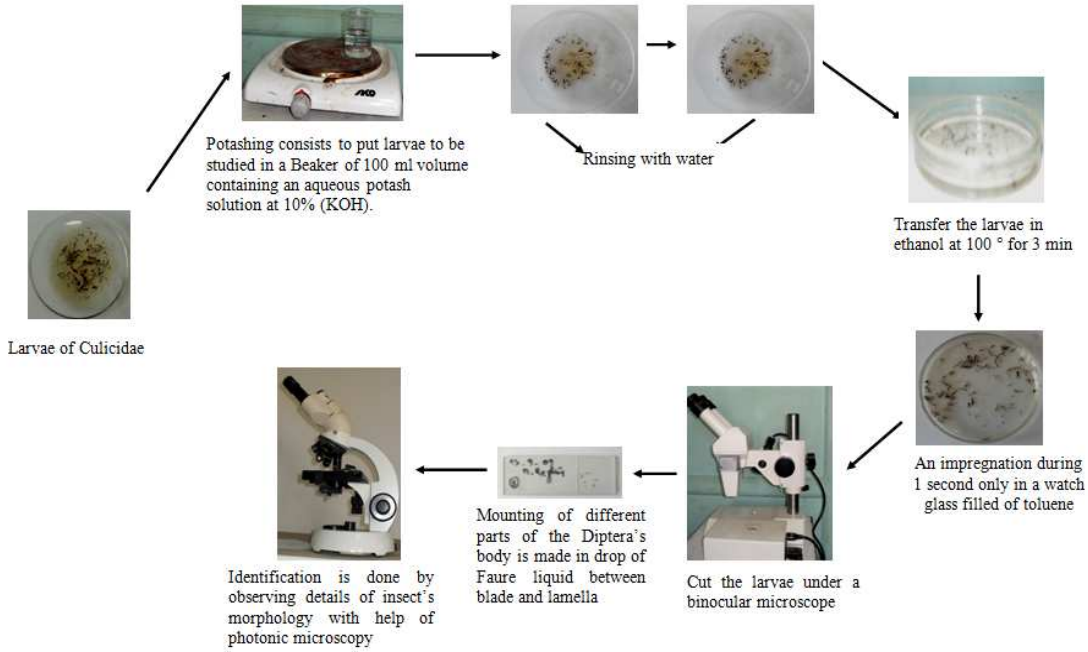

Fig. 2: The mounting technique of genitalia and aquatic larvae (Original photography)

RESULTS AND DISCUSSION

The orders which present different species trapped thanks to the three sampling methods notably the yellow plates, the sweep net and fishing of water larvae are mentioned in table 1. During the present study conducted

for a period going from July to September 2009 in the Lake of Reghaïa to identify invertebrate's species, essentially Diptera of different interests. It was noted 3364 individuals belonging to 22 orders by using three sampling methods are those one of yellow plates, the sweep net and larvae's harvest, where Diptera represent 1630 individuals. The results obtained are interpreted first of all, in species richness term for each order, then by abundance of different orders particularly the Diptera order.

Within the 15 orders noted in the yellow plates on the edge of the swamp or Reghaîa Hymenoptera occupy the first rank with 33 species (Table 1). They are similar to those of Diptera with 31 species. Other orders intervene weakly as Homoptera with 19 species. [11] report in the same station and in yellow containers a monthly richness of 67 invertebrates with 20 species of Diptera in July, 53 invertebrates in August and 49 invertebrates in September with 13 species of Diptera for both months. In 1636 individuals, the highest rate is marked by Homoptera with 68.5% with 1121 individuals followed by Hymenoptera with 12.8% by 210 individuals and Diptera with 12.4% with 202 individuals. The remaining rate concerns 11 others categories (Fig. 3).

Diptera comprise Nematocera and Brachycera. It is useful to mention that Nematocera belong to Cecidomyidae, Psychodidae as *Psychoda* sp. and *Phlebotomus* sp., to Chironomidae, Sciaridae andTipulidae. Cyclorrhapha constitute the essential of Brachycera species trapped. Determined genders are notably, *Machimus* sp., *Helophilus* sp., *Eritaslis* sp., *Sepsis* sp. without going to the species. [62] used yellow plates at level of Jardin d'Essai of El HAMMA trapping 38 Diptera species. Among these latter, this same author noted *Psychoda* sp. and *Phlebotomus* sp. (Psychodidae), several Cecidomyidae as *Lestremia leucophea*, *Mycodiplosis coniphaga*, *Rhopolomya* sp., one species of Simuliidae (*Simulium erythrocephalum*), one Ceratopogonidae (*Culicoides minutissimus*) and one species of Mycetophilidae with *Mycomyia* sp. [17] in beans' plot (*Vicia faba*) in Technical Institute of Great Cultures of Oued Smar, near El Harrach (T.I.G.C) note in the coloured traps, presence of 98% of insecta with 66.9% of Diptera (Nematocera and Brachycera Cyclorrhapha), followed by Hymenoptera 13.9% and Podurata (11.5%). In the same cultivation type, in a bean's field in suburb of El Harrach, we captured in yellow traps, 182 species with 4 Gastropoda.16 Arachnida and 162 Insecta species (89.0%) [16].

Table 1: list, richness and relative abundance (R.A.%) of invertebrates orders particularly of Diptera trapped in different types of traps in Lake of Reghaîa

Traps type	Y.P. (Borders)			S. N. (Bushes)			S.N. (Borders)			R. larvae		
Orders	ni	S	RA(%)	ni	S	RA(%)	ni	S	RA(%)	ni	S	RA(%)
Gasteropoda	-	-	-	4	2	2,02	1	1	0,33	-	-	-
Pseudoscorpionida	2	1	0,12	-	-	0,00	-	-	-	-	-	-
Aranea	21	6	1,28	17	6	8,59	48	9	15,64	-	-	-
Acari	5	2	0,31	-	-	0,00	1	1	0,33	-	-	-
Isopoda	1	1	0,06	1	1	0,51	-	-	-	-	-	-
Podurata	46	3	2,81	3	1	1,52	-	-	-	1	1	0,07
Blattoptera	1	1	0,06	-	-	0,00	-	-	-	-	-	-
Orthoptera	1	1	0,06	-	-	0,00	7	3	2,28	-	-	-
Plecoptera	-	-	-	-	-	0,00	-	-	-	193	1	12,61
Thysanoptera	11	2	0,67	-	-	0,00	-	-	-	2	1	0,13
Anisopodidae	-	-	-	-	-	0,00	-	-	-	11	1	0,72
Odonatoptera	-	-	-	1	1	0,51	-	-	-		-	-
Zygoptera	-	-	-	-	-	0,00	-	-	-	147	1	9,61
Psocoptera	2	1	0,12	-	-	0,00	1	1	0,33	-	-	-
Heteroptera	2	2	0,12	9	2	4,55	16	6	5,21	5	1	0,33
Homoptera	1121	20	68,52	12	5	6,06	36	7	11,73	2	1	0,13
Coleoptera	10	7	0,61	12	7	6,06	15	7	4,89	22	1	1,44
Nevroptera	-	-	-	-	-	0,00	2	1	0,65	-	-	-
Hymenoptera	210	32	12,84	24	14	12,12	12	6	3,91	-	-	-
Lepidoptera	1	1	0,06	2	2	1,01	-	-	-	-	-	-
Diptera	202	31	12,35	113	10	57,07	168	13	54,72	1147	5	74,97
22 orders	1636	111	100	198	51	100	307	55	100,00	1530	13	100

Y.P.: yellow plates; S.N.: Sweep net, R.: Recolte, R.A.%: Relative abundance; (-): Absence of order in the. ni: number of individuals

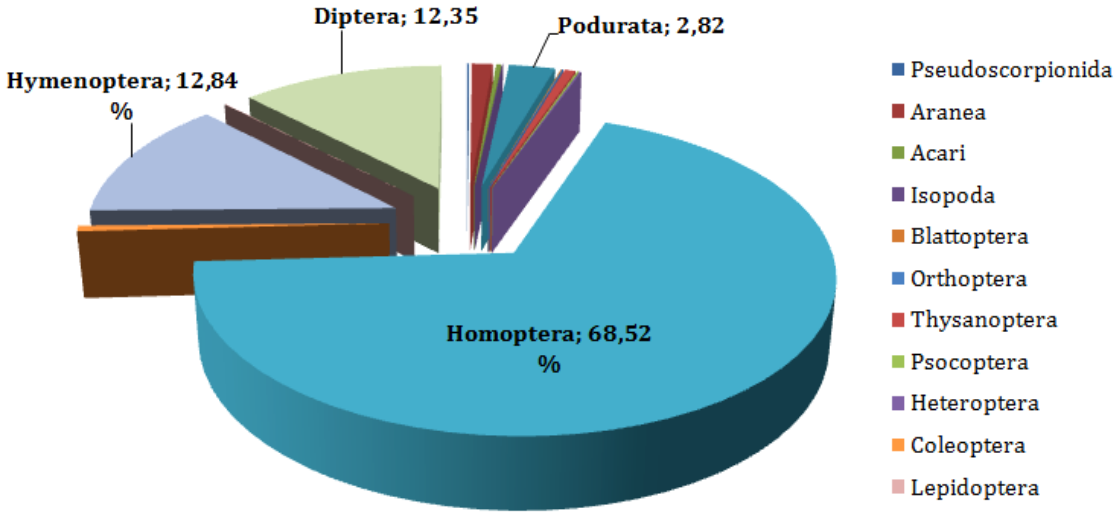

Fig. 3: Relative abundance (R.A.%) of invertebrates orders particularly of Diptera trapped in yellow plates in orders Lake of Reghaîa

The technique of yellow plates is used with inspired manner by [2] and [1] at El Misser in the forest of Aggouacha (Larbaâ Nath Irathen) showing that in function of species numbers, Insecta with 89.8% occupy the first rank in front of Arachnida (7,0 %), Podurata (2,3 %), Myriapoda (0,5 %) and Thysanourta (0,5 %). Among Insecta, there are Diptera which dominate in individuals number (n = 329; 25,1 %) while Hymenoptera arrives in the first rank in species term (54). Among Diptera [2] have trapped species belonging to Trichoceridae, Mycetophilidae, Sciaridae, Cecidomyidae and ipulidae. Particularly, *Dryomia coccifera* and *Psychodes* sp have been recognised.

A whole of 51 species are trapped thanks to sweep net in the bush in front of the water body of Reghaia Swamp (Table 1). Among 11 other orders and far with 14 species the one of Hymenoptera is in the first rank. It is followed by Diptera with 9 species belonging notably to Cecidomyidae, Culicidae, Psychodidae, Chironomidae et aux Agromyzidae and Coleoptera with 7 species. Near edges of Reghaîa's Swamp, content of the sweep net comprises 12 orders, with 13 species of Diptera occupying the first place. They are followed by those of Arachnidan with 9 species and other orders with similar percentages (Table 1).

As for relatives abundance (R.A%) of captured species in sweep net at level of Reghaîa Swamp's bush, 198 species are noted (Tab 1). Diptera order occupies the first rank 113 individuals on 198 (57.1%) (Fig.4). In actual fact, this is due to pullulating of Chironomidae (*Chironomus* sp. ind.) species with 76.1%. In sweep net on edge of Reghaîa Swamp, 307 individuals (55 species) are noted (Table 1).

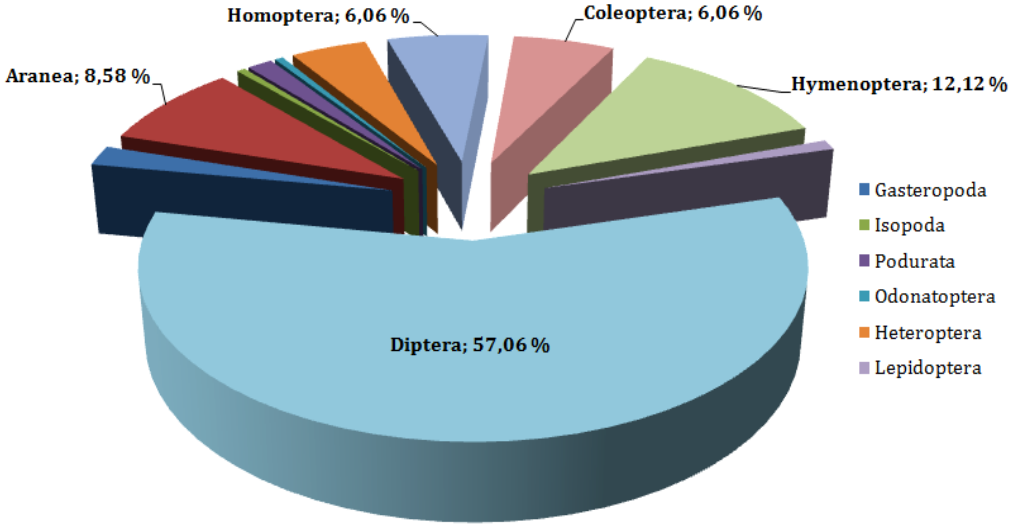

Fig. 4: Relative abundance (R.A.%) of invertebrates orders particularly of Diptera trapped by a technique of sweep net at level of Reghaîa Swamp's bush

The highest percentage concerns Diptera with 54.7% 5 (Fig. 5). In the same environment type, on the edge of the same swamp but thanks to trapping in Barber pots, to sweep net and insects captured in flight with a butterfly net, [40] captures 104 species with 8 Odonatoptera notably *Ceriagrion tenellum, Brachythemis leucosticta, Ischnura graellsii, Crocothemis erythraea, Anax imperator* an *Orthetrum ramburii*, 19 species of'Orthoptera, 12 species of Heteroptera, 12 species of Homoptera, 49 species of Coleoptera, 13 species of. Hymenoptera, 21 species of Lepidoptera and 8 species of Diptera.

In the present study neither dragonfly, nor damselfly were trapped in the sweep net. Thanks to the same technique in an orchard at Beni-Tamou near Blida, 142 species belonging to 17 orders and 4 classes were captured [13]. This author shows that Heteroptera with specie of *Mecomma* sp. which occupy the first rank. The numerical gap of captures may be explained by difference of sampling period duration. As for composition of the trapped fauna, differences depend of the prospected environment types. Technique of sweep net is used also by [2] at El Misser in the forest of Ait Aggouacha (Larbaâ Nath Irathen). These authors show Insecta class occupying the first place as in species term (75.7%) as in individual's term (76.4%) and that Diptera species (12.3%) present are among the Nematocera, Tipulidae, Sciaridae and Cecidomyidae and more precisely *Dolichopeza* sp. Among Brachycera they not too much of Cyclorrhapha as Lucilia sp., *Tephritis* sp. and *Rivellia* sp.

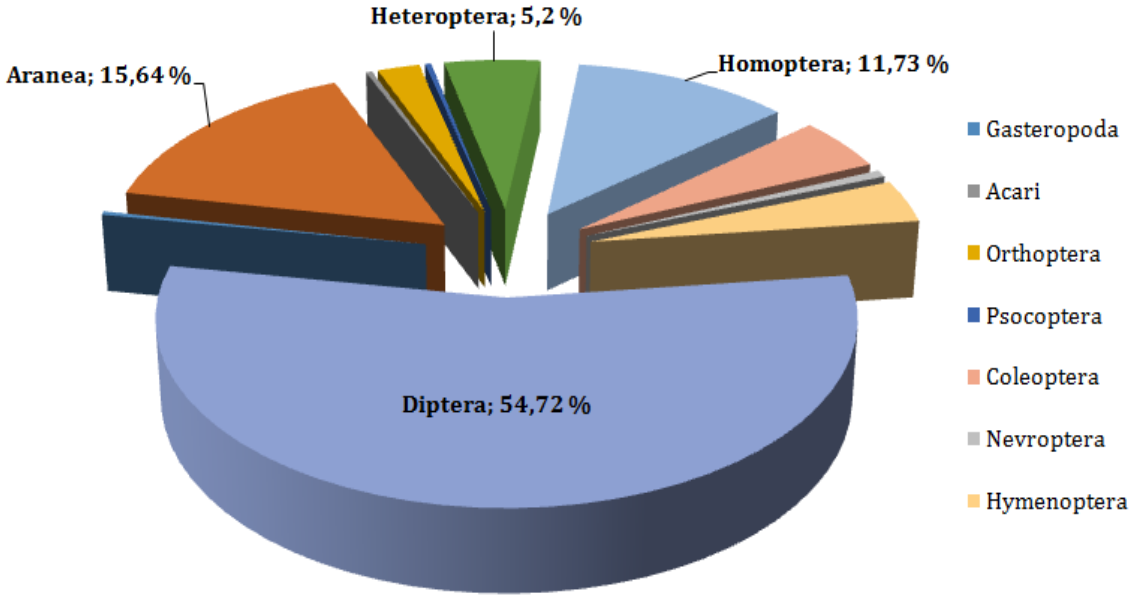

Fig. 5: Relative abundance (R.A.%) of invertebrates orders particularly of Diptera trapped by a technique of sweep net at the borders Lake Reghaîa

By using sweep net in steppe environment in Fait El Botma near Djelfa and by concentrating on Orthopter [7] counts 15 species with 5 Gomphocerinae with *Omocestus raymondi, O. ventralis, Ochrilidia kraussi, O. rothschildi* and *O. gracilis*, 2 Acridinae as *Ramburiella hispanica* and *Acrida turrita*, 1 Pyrgomorphidae (*Pyrgomorpha cognata)*, 2 Pamphagidae with *Tmethis pulchripennis* and *Acinipe* sp. The harvest results of larvae reveal presence of 9 orders with 13 species where five belong to Diptera order, these are *Culex mimeticus, Culex perexiguus, Culex impudicus, Uranotaenea unguiculata* and *Anopheles labranchiae* (Tabale 1) With this known technique of larvae capture [9, 11] note presence of 4 Diptera species in August, 3 in September and 5 in October. Larvae of different ages and Culicidae nymphs are noted. It should be noted that other insect's species are observed in the water as larvae of Zygoptera *Coenagrion* sp., d'Anisoptera Libellulidae, pictures of Naucoridae (*Naucoris* sp.), and larvae of different stages of Dytiscidae and Plecoptera.

To those, it must be associated species accidentally fallen in the water as Aphidae and Lygaeidae. In study of a preliminary report of mosquitoes survey at Tonga Lake (North-East Algeria), [31] notifie a richness of 8 species of Culicidae by using the same sampling technique. We should remember that [36] harvested in the same site, 10 species of Culicidae. These are *Culex* (*Culex*) *pipiens, Culex* (*Culex*) *mimeticus, Culex* (*Culex*) *perexiguus, Culex* (*Culex*) *theileri, Culex* (*Barraudius*) *modestus, Culex* (*Neoculex*) *impudicus, Culex* (*Neoculex*) *territans, Culex* (*Maillotia*) *hortensis, Culiseta* (*Allotheobaldia*) *longiareolata* and *Uranotaenia* (*Uranotaenia*) *unguiculata0* The new species seen is *Anopheles* (*Anopheles*) *labranchiae*. The last species quoted is reported in waters of Sebaou in 2002-2003 [36]. In Algiers'region including Reghaîa' Swamp and El Alia, 13 species of Culicidae are identified thanks to several captures techniques implemented by [37]. To the

previous list, it should be added *Aedes* (*Ochlerotatus*) *caspius* and *Culiseta* (*Culiseta*) *subochrea*. [59] in their Entomofauna inventory of Birds 'Lake (wilaya of El Taref Algeria) used the dripping technique (Harvested thanks to a dipper) during eight outings from March until October 2015. They noted presence of four orders: they are Hydracariens, Hétéroptéra, Coléoptéra and Diptera with species belonging to Culicidae family.

It is also noteworthy the harvest of 1530 individuals in waters of Reghaîa Lake (Table 1).Order of Diptera is best represented with 1147 individuals with a highest percentage of 75%. *Culex pereguiguus* (42.2 %) and *Culex mimeticus* (38,3 %) largely predominate (Fig. 6).

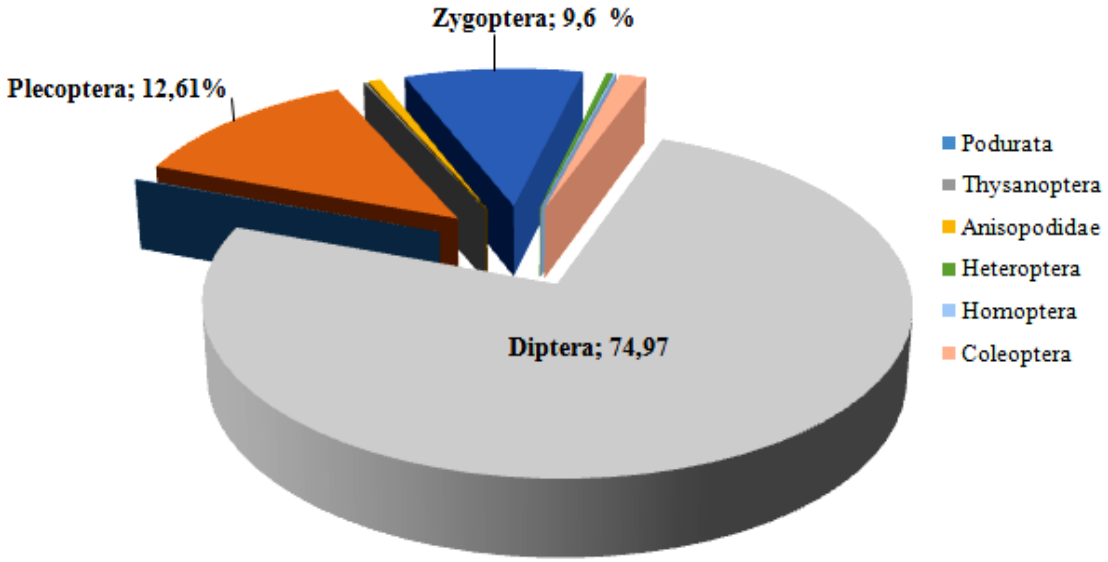

Fig. 6: Relative abundance (R.A.%) of invertebrates orders principally of Diptera trapped by the dripping technique in borders in waters of marsh Reghaîa

Apparently the presence of water body favours installation and pullulating of Diptera. That is not only the single factor that intervenes. [19] by using a kick net to inventory arthropod fauna of Taksebt Dam in Tizi-Ouzou have harvested 1432 individuals in both sampling stations. That which confirms the results obtained in the present study. By contrast, they refute those noted during study of temporal spatial distribution of aquatic invertebrates in a stream of Haute Tafna (North-West of Algeria) 2013 by BENKEBIL, [31] catch 3496 individuals in waters of Tonga Lake with 65,6% representing by *Culex pipiens* (Linnaeus, 1758). [5] who reported 6679 individuals spread in 36 taxa [18] using the three trapping techniques than of the present work, have identified 37 species belonging to 18 families in Dam's Taksebt (Tizi-Ouzou) with a remarkable presence of Tipulidae, Chironomidae and Culicidae with four species for the latter. During the follow-up of Culicidae seasonal abundance in humid ecosystem of national park of El Kala by [60] by using dripping of a capacity of 500 ml for larval fishing in two suberaies at level of ponds, troughs, natural or artificial water harvesting, tree holes and also in artificial habitats voluntarily installed in the forests. it has noted 14 Culicidae diptera species including 1412 individuals with dominance of *Culex pipiens* with 56,59% followed by *Culex theileri* with 19,55 % (276 individuals) and *Anopheles labranchiae* by 9,56 % (135 individuals).These results refute those noted in this study because only *Anopheles labranchiae* which was captured with a very low percentage of our species trapped in the Lake water of Reghâia by 0.17%.

Conclusion:

During bio-ecological and systematic study with the purpose to illustrate place of Diptera among invertebrates of Reghaîla Lake, three trapping techniques used from July to September 2009 are those of yellow plates, sweep net, and capture larvae in water, these last ones seem to be interesting for capture of maximum Diptera species from the point of view quantitative and qualitative. Diptera form a very important order among invertebrates of Reghaia's natural reserve, this ranking is justified by the high individual's number captured in a short period. As well since it comprises at the same time, useful species and other useless, this composition in species of captures made in the Lake, depends of several factors.

In reality, presence of Psychodidae finds its explanation in presence of ammonia emissions from bovine's urine adjoining grazing land located in South-West of Reghaîa Swamp. Capture of several other Diptera species is explained by bush proximity overlooking the lake occupied by flower crops (Chironomidae, Bibionidae). In

addition of Brachycera corresponding to the families of Stratiomyidae, of Asilidae (Machinus sp.), of Syrphidae (Eristalis sp., Helophilus sp.), of Pipunculidae, of Agromyzidae, of Drosophilidae, of Sepsidae, of Conopidae (Zodion sp.), of Sarcophagidae and Calliphoridae (Calliphora sp.). But trapping of Phlebotomus sp. may create serious concern. Fortunately, their number is modest. Trapping of hygrophilous species in large number of individuals as Chironomidae is to be noted, thus their larvae can intervene in feeding of fish, batrachians and water birds of Reghaia Lake. It should be noted richness of the latter in Culicidae (Culex periguiguus, Culex impudicus, Culex mimeticus and Uranotaenia unguiculata) and in Psychodidae (Anopheles labranchiae). Medical and veterinary entomologist considers that they are the main vectors of infectious diseases, quoting malaria which is transmitted to human.

In another study framework, the three sampling techniques are learned. However, we must increase the sampling frequency of 2 times a month, the 10 and the 20 of every month so as to detect outbreaks of certain pest species. Moreover, it would be useful to be limited to only Diptera and book more attention to the Brachycera. It would be desirable to increase the stations in Algiers, in the plain of Mitidja, perhaps in basements of buildings and various ponds for harvesting larvae. We must pursue the dual sampling effort in determination as Diptera Brachycera and Nematocera that medical-veterinary and agricultural interest. Greater taxonomic research towards Chironomidae is expected. To the extent possible it would be interesting to include the capture of aquatic larvae in the downtown portion of the Tell Atlas and Highlands. Educational keys, simple Nematocera and Brachycera deserve to be developed for the recognition of the species present in Algeria. This is the program proposed for a possible study in another research setting.

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Subject Contributions to knowledge:

This study contributes to the enhancement of wetlands. Which are the ecosystems of major importance, but unfortunately they are poorly managed by man. Some sites, however, were protected but others have little leverage. First, this study put the point on the remarkable richness of one of these areas (Lake Regaïa, Algeria). The large variety of biological processions of this quote is an excellent teaching tool to raise awareness of diversity, dynamics and functioning of various ecosystems existing in the swamp as the Maquis, as Mars, as agricultural farms, of grazing land (sheep and cattle), of dune pre beach and of the homes. On the other hand, from the scientific point of view, the qualitative and quantitative inventory of groups of Diptera gives an overview on the level of human threats of this reserve. There are still many functional aspects to clarify which seems essential for long-term management of these environments in the context of sustainable development.

REFERENCES

[1] Amrouche, L., 2010. Diversité faunistique de la forêt d'Ait Aggouacha (station d'El Misser). Ecole Nationale Supérieure d'Agronomie, El Harrach, pp: 225.
[2] Amrouche, L., H. Benmessaoud-Boukhalfa, S. Doumandji and Z. Sobhi, 2010. Contribution à l'étude de l'arthropodofaune de la forêt d'Ait Aggouacha (station d'El Misser). Jour. Nat. Zoo.Agr. For., Dép. zool. for., Eco. Nat. Sup.Agr., pp: 113.
[3] Barros de Carvalho C., 2002. Muscidae (Diptera) of the neotropical region: Taxonomy. Ed. U.F.P.R., Curitiba - Parana, pp: 287.
[4] Benhamed, D., F. Bendali-Saoudi, N. Soltani, 2016. Effect of two blood meal types on reproduction and developmentin the mosquito Anopheles maculipennis. Journal of Entomology and Zoology Studies, 4(2): 335-339.
[5] Benkebil, Z., N. Belaidi and A. Taleb, 2016. Distribution spatio-temporelle des invertébrés aquatiques dans la haute Tafna (Nord-Ouest Algérien). 1er Séminaire International sur la Biodiversité et la Gestion des Ressources Naturelles, pp: 115.
[6] Benkhelil, M.A., 1991. Les techniques de récoltes et de piégeages utilisées en entomologie terrestre. Ed. Office Pub. Univ., Alger, p: 68.
[7] Benmadani, S., 2010. Biosystématique des Orthoptères dans la région de Djelfa et régime alimentaire de quelques espèces du genre Euryparyphes. Thèse Magister, Alger: Eco. Nat. Sup. Agr., p: 180.
[8] Bella-Santini., 1976. La pollution des eaux marins. Ed. Gauthier- Villars, Paris, p: 230.
[9] Berrouane, F.Z., K.Soutou and S. Doumandji, 2011. Bioécologie et systématique des Diptera près du marais de Réghaïa. Séminaire International sur la Protection des Végétaux, Alger : Ecole Nationale Supérieur d'Agronomie.

[10] Berrouane, F., D. Berrabah, K. Soutou and S. Doumandji, 2012. Aspect bioécologique et systématique des Invertébrés en particulier des Diptera capturées dans les pièges colorés prés du Marais du Réghaïa. Tiaret : Université Ibn Khaldoun, 1er Colloque national sur la lutte biologique et le développement durable dans les écosystèmes naturels et anthropisés.
[11] Berrouane, F.Z., Z. Lounaci, K. Souttou and S. Doumandji, 2016. Biodiversité de l'entomofaune dans l'un des écosystèmes humide Algériens (Lac de Reghaia). Colloque National : La Biodiversité en Algérie : Connaissance, valorisation & Conservation, pp: 47.
[12] Bouaziz, A., S. Daoudi-Hacini and S. Doumandji, 2016. Insects in the Diet of Common Chiffchaff Phylloscopus collybita Surroundings Tonga Lake, North East of Algeria. Global Veterinaria, 16(3): 219-221.
[13] Boukeroui, N., S. Doumandji and N. Chebouti-Meziou, 2007. L'entomofaune du pistachier fruitier (Pistacia vera Linné) dans la région de Blida. Jour. Intern. Zool. Agri. For., Alger : Inst. Nati. Agro., p: 203.
[14] Boukraa, S., M.A. La Grandiere, T. Bawin, F.N. Raharimalala, J.Y. Zimmer, E. Haubruge, E. Thiry and F. Francis, 2016. Diversity and ecology survey of mosquitoes potential vectors inBelgian equestrian farms: A threat prevention of mosquito-borneequine arboviruses. Preventive Veterinary Medicine, 124: 58-68.
[15] Boulkenafet, F., S. Berchi and S. Lambiase, 2015. Preliminary study of necrophagous Diptera succession on a dog carrion in Skikda, North-east of Algeria. Journal of Entomology and Zoology Studies, 3(5): 364-369.
[16] Boussad, F., 2006. Relations Invertébrés – fève (Vicia faba Linné). Comportement d'Aphis fabae Scopoli sur quatre variétés de fève dans la banlieue d'El Harrach. Thèse Magister, Alger : Inst. Nati. Agro., pp: 179.
[17] Boussad, F. and S. Doumandji, 2004. La diversité faunistique dans une parcelle de Vicia faba (Fabaceae) à l'institut technique des grandes cultures d'Oued – Smar. 2ème Journée protection des végétaux, Alger : Inst. Nati. Agro., p: 19.
[18] Brahmi, K., A. Ouelhadj, D. Guermah and S Doumandji, 2013. Inventaire des diptères en particulier ceux d'intérêt médico-vétérinaire dans le Barrage Taksebt et la ferme d'élevage à Fréha (région de Tizi-Ouzou, Algérie). 11ème Journée entomologique de Gembloux « L'entomologie, une science réservée aux professionnel (le)s ? », p: 13.
[19] Brahmi, K., S. Yermeche, D. Smail and S. Doumandji, 2014. Inventaire de la faune Arthropodologique du [20] Barrage de Taksebt (Tizi-Ouzou), et étude de la qualité de l'eau. Séminaire National sur la Biodiversité faunistique, p: 24.
[20] Callot, J.J. and Helluy, 1958. Parasit. Méd., Ed. Médicales Flammarion, Paris, p: 645.
[21] Chopard, L., 1943. Orthoptéroïdes de l'Afrique du Nord. Ed. Libraire Larouse, Coll. " Faune de l'empire français ", T. I, Paris, pp: 450.
[22] Delvare, G. and H.P. ABERLANC, 1989. Les insectes d'Afrique et d'Amérique tropicale clés pour la reconnaissance des familles. Ed. GERDAT, Montpellier, p: 202.
[23] Faurie, C., C. Ferra and P. Medori, 1980. Ecologie. Ed. Baillière J. B., Paris, p: 168.
[24] Fontaine, M., G. Bellen, F. Ramade, J. Ancellini, M. Lelourd, P. Michel, M. Gauthier, F. Soudane and D.
[25] Gil Ortiz, R., 2009. Biosystematic contributions to Agromyzidae (diptera). Ph. D. dessertation, Valencia: Universidad Politécnica, p: 442.
[26] Goetghebuer, M., 1932. Diptères: Chironomidae. Ed. Paul Lechevalier, Paris, p: 204.
[27] Grasse, P.P., 1985. Abrégé de zoologie. Ed. Masson, Paris, p: 250.
[28] Haupt, J.H., 1998. Guide des mouches et de moustiques : l'identification des espèces européennes. Ed. Delachaux et Nistlé, Suise, p: 352.
[29] Jeanbourquin, P., 2005. The Role of Odour Perception in the Sensory Ecology of the Stable Fly, Stomoxys calcitrans L. Ph. D. dessertation, Neuchâtel University, p: 107.
[30] Korba, R.A., S. Boukraa, M.S. Alayat, M.L. Bendjeddou, F. Francis, S.C. Boubidi and Z. Bouslama, 2015. Preliminary report of mosquitoes survey at Tonga Lake (North-East Algeria). Adv. Environ. Biol., 9(27): 288-294.
[31] Lamotte, M. and F. Bourliere, 1963. Problème d'écologie : L'échantillonnage des peuplements animaux des milieux terrestres. Ed. Masson et Cie, Paris, p: 303.
[32] Lany, M., 1997. Les insectes et les hommes. Ed. Albin Michel, S.A., Paris, p: 415.
[33] Leclercq, M., 1971. Les mouches nuisibles aux animaux domestiques. Ed. Les Presses Agronomiques Gembloux, A.S.B.L., p: 199.
[34] Leraut, P., 2003. Le guide entomologique. Ed. Delachaux et Niestlé, Paris, p: 527.
[35] Lounaci, Z., 2003. Biosystématique et bioécologie des Culicidae (Diptera , Nematocera) en milieux rural et agricole. Thèse Magister, Alger : Inst. Nati. Agro., p: 324.
[36] Lounaci, Z. and B. Doumandji-Mitiche, 2004. Biosystématique des Culicidae (Diptera : Nematocera) dans la partie sub-urbaine de l'Algérois, du marais de Réghaïa et de l'Oued Sébaou de Tizi Ouzou. 2ème Jour. Protec. Végét., Alger : Inst. Nati. Agro., p: 45.
[37] Matile, L., 1993. Diptères d'Europe occidentale. Ed. Boubée, Paris, T. I, p: 439.

[38] Matile, L., 1995. Diptères d'Europe occidentale. Ed. Boubée, Paris, T. II, p: 380.
[39] Molinari, K., 1989. Etude faunistique et comparaison entre trois stations dans le marais de Réghaïa. Thèse Ingénieur, Alger : Inst. Nati. Agro., p: 171.
[40] Pandrangi, A., 2013. Etiology, pathogenesis and future prospects for developing improved vaccines against bluetongue virus: A Review. African Journal of environmental Science and Technology, 7(3): 68-80.
[41] Perie, P., R. Chermette, Y. Millemann and S. Zientara, 2005. Les Culicoides, Diptères hématophages vecteurs de la fièvre catarrhale du mouton. Bull. Acad. Vét. France,Tome, 158(3): 213-224.
[42] Perrier, R., 1927 a. La faune de la France - Hémiptères Anoploures, Mallophages, Lepidoptères. Ed. Librairie Delagrave, Paris, Fasc. 4 : 243.
[43] Perrier, R., 1927 b. La faune de la France - Coléoptères (Première partie). Ed. Librairie Delagrave, Paris, Fasc. 5 : 192.
[44] Perrier, R., 1927 c. La faune de la France - Coléoptères (Deuxième partie). Ed. Librairie Delagrave, Paris, Fasc. 6 : 229.
[45] Perrier, R., 1940. La faune de la France, Hyménoptères. Ed. Delagrave, Paris, T. VIII, p: 211.
[46] Perrier, R., 1983. La faune de la France, les Diptères, Aphaniptères. Ed. Delagrave Paris, T.VII, p: 216.
[47] Pierre, C., 1924. Diptères: Tipulidae. Ed. Paul Lechevalier, Paris, p: 159.
[48] Ramade, F., 2009. Eléments d'écologie – Ecologie fondamentale. Ed. Dunod, Paris, p: 689.
[49] Rodhain, F. and C. PEREZ, 1985. Précis d'entomologie médicale et vétérinaire. Ed. Maloine S. A., Paris, p: 458.
[50] Roth, M., 1980. Initiation à la morphologie, la systématique et la biologie des insectes.Ed. O. R.S.T.O.M., Paris, p: 213.
[51] Rouaiguia, M., N. Lahlah, E. Bensaci and M. Houhamdi, 2015. Feeding behaviour and the role of insects in the diet of northern house-martin (Delichon urbica meridionalis) nestlings in northeastern Algeria. African Entomology, 23(2): 329-341.
[52] Seguy, E., 1923. Diptères Anthomyides. Ed. Paul Lechevalier, Paris, p: 393.
[53] Seguy, E., 1926. Diptères Brachycères (Stratiomyijdae. Erinnidae. Coenomyiidae. Rhagionidae. Tabanidae. Codidae, Nemestrinidae. Mydaidae. Bombyliidae. Therevidae, Omphralidae). Ed. Paul Lechevalier, Paris, p: 308.
[54] Seguy, E., 1927. Diptères Brachycères (Asilidae). Ed. Paul Lechevalier, Paris, p: 190.
[55] Seguy, E., 1934. Diptères Brachycères (Muscidae Acalypterae et Scatophagidae). Ed. Paul Lechevalier, Paris, p: 832.
[56] Seguy, E., 1940. Diptères nématocères. Ed. Paul Lechevalier, Paris, p: 398.
[57] Serradj, N., Z. Dehchar, M. Houmani, F. Bendali –Saoudi and N. Soltani, 2016. Inventaire de l'entomofaune du lac des oiseaux (wilaya d'el taref Algérie). 1er Séminaire International sur la Biodiversité et la Gestion des Ressources Naturelles, p: 28.
[58] Tahraoui, C., 2012. Abondance saisonnière des Culicidae dans l'écosystème humide du parc national d'El-Kala. Identification et lutte. Thèse de Magister, Annaba : Université Badji Mokhta, Faculté des Sciences, p: 75.
[59] Taibault, M., 2006. Plan de gestion de la Réserve Naturelle du Lac de Réghaïa (Algérie). Projet LIFE 3,TCY/INT/031. Maghreb Zones Humides, Protection et Développement Durable des Zones Humides en Afrique du Nord, Ed. Toure de Valat, p: 82.
[60] Tamaloust, N., 2007. Bioécologie des nématocères dans l'Algérois. Essai de lutte biologique par Metarhizium anisopliae contre les larves de Culex pipiens Linné, 1758 (Nematocera, Culicidae). Thèse Magister, Alger : Inst. Nati. Agro., p: 155.
[61] Villiers, A., 1977. L'entomologiste amateur. Ed. Lechevalier S.A.R.L., Paris, p: 248.
[62] Wyss, C. and D. Cherix, 2006. Traité d'Entomologie Forensique: Les insectes sur la scène de crime. Presses Polytech. Lausanne: Univ. romandes, p: 317.
[63] Zahradnik, J. and F. SEVERA., 1978. Guide des insectes. Ed. Hatier, Fribourg, p: 318.
[64] Zimmer, J.Y., B. Losson, C. Saegerman, N. Kirschvink, E. Haubruge and F. Francis, 2013. Comparaison des populations de Culicoides Latreille 1809 (Diptera : Ceratopogonidae) présentes au sein d'une bergerie belge et d'une prairie ovine associée. Annales de la Société entomologique de France (N.S.), 49(4): 446-459.
[65] Zimmer, J.Y., B. LOSSON, C. SAEGERMAN and E. HAUBRUGE, 2008. Ecologie et distribution des espèces de Culicoides Latreille 1809 (Diptera : Ceratopogonidae) a proximite d'une exploitation bovine en Belgique. Ann. soc. entomol. Fr. (n.s.), 45(3): 393-400.