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Memory

OVERVIEW OF OBTAINING THE DIPLOMA MASTER

Domain: SNL **Sector**: Ecology and Environment

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Presented by

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Theme

Study of the biological diversity of wild bee populations in the Djurdjura National Park

Supported on: 27/06/2024 **Before the jury composed of:**

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Thanks

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In the end, we can only express our sincere thanks to all the people who contributed directly or indirectly to the completion of this work.

Dedication

This work is the result of sustained commitment and I wish to dedicate this work to those who played a significant role in its completion.

To my dear parents, my sisters and my brothers who supported me throughout my journey.

To my friends and everyone who was there to support me.

Nada

Dedication

This work is the result of sustained commitment and I wish to dedicate this work to those who played a significant role in its completion.

To my dear grand parents, my mom aunts and my uncles who supported me throughout my journey.

To my friends and everyone who was there to support me.

Narimane

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- **PND :** Parc national djurdjura
- **FWL :** Fore wings length
- **FWW :** Fore wings width
- **HWW :** Hind wings width
- **HWL :** Hind wings length

Summary

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Introduction

Since ancient times, bees have always fascinated people. These insects appear on sunny days and visit flowers. In the wild, apoids have great ecological importance for maintaining the diversity of native plants and the entire trophic cascade that unfolds **(Vaissiere, 2005)**. In agro-ecosystems, the role of these insects is mainly of economic importance because they positively influence agro-food production **(Payette, 2004).**

Bees are insects of the order Hymenoptera and the super family Apoidea. This super family is divided into seven distinct families Andrenidae, Apidae, Colettidae, Halictidae, Megachilidae, Melittidae, Stenotritidae.The distribution of this fauna depends on several factors, such as flora, climate, also the ability of bees to disperse and reach suitable areas. Bees are very abundant and diversified in temperate regions (North-East America, Europe, and the extreme south of Brazil to Argentina) **(Michener, 2000)**. However, the greatest wealth is recorded in regions with Mediterranean climate such as North Africa and the west coast of the United States (California). The least rich regions are extreme South Africa, arid regions and tropical savannahs, extreme northern Australia, equatorial savannahs and finally East Africa.

Even today, we are far from knowing all these bees completely. If some species remain to be discovered, their ethology, their biology, their distribution are still very little known. In addition, knowledge of the diversity of bees, especially those that are wild, becomes necessary for the maintenance and conservation of populations. They play an important role in pollinating many plants **(Michez, 2002)**, food security and maintaining ecological biodiversity.

Their high mobility, which for some can extend over long distances, is also a determining factor in maintaining the genetic flow of remote populations **(Velterop, 2000).**

Until recently, little was known about wild bees in Algeria . Only a few research work exist in the literature, and these work were old or fragmentary**.**

Our study is a first contribution to the knowledge of the biodiversity of wild bees in two localities, Tikjda mountaines (1400m), wehre the evironmental condition are less disturbed and Errich forest where the pollution are very high (500m). Several parameters were measured, such a weight and length of each idividual, length of atnenna, legs, wings and togue of bees. Also, we have identified the family, gender and species for each individuals.

Literature review

I. Generality about the bees

The bees is a social insect belonging to the order of hymenoptera **(Plateaux *et al.*, 1982)**. They appeared 45 million years before man **(Daniel, 1983)**. However, some paleontologists discovered their fossils in Baltic amber for more than 60 million years **(Winston, 1993)**.

There are 6 bees families worldwide and more than 20.000 species in various geographical areas in term of climate and resources. The best known and most used in beekeeping are in the genus *Apis* and are part of the species *Apis mellifera* with several geographical breeds that currently inhabit in Europe, Africa, West Asia, North America, South America, Australia and New Zealand **(Giraudet, 2008).**

1 Systematic position of wild bees

Bees belong to the animal kingdom and are classified in the branch of arthropods; the insect class comprises 32 orders in that of hymenoptera to which the bees belong **(Aguib, 2006)**.

The systematic position of bees established by (**Michener, 1944) was:**

Reign: Animalia

Sub-Reign: Metazoa

Division: Eumetazoa

Subdivision: Bilateralia protostomiens coelomates avec articulation (Articulata)

Branch: Arthropod

Subbranch: Hexapoda

Class: Insecta

Super-order: Oligo-Neoptera

Order: Hymenoptera

Sub-order: Aculeata

Super-family: Apoidea

2 Morphology of wild bees

Like all insects, bees have a body divided into three parts (head, thorax, and abdomen) (**Michez *et al.*, 2004)**. The head and thorax are clearly distinct from the abdomen because of the existence of a very clear narrowing, which is after the first abdominal segment, which is morphologically part of the thorax; the second segment, in fact, is strangled and connected, in the back, in the pedunculate abdomen.

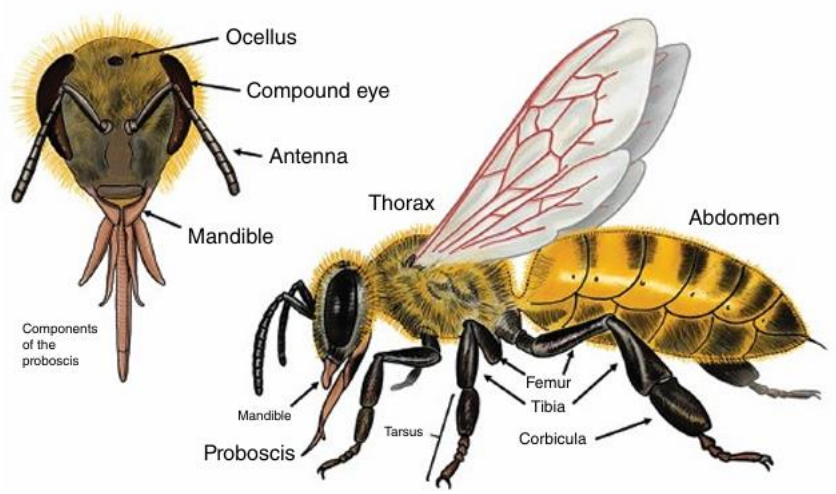

Figure 1: The morphology of the honeybee **(Faux ,2021)**

2.1 The head

Carries the oral parts, antennae, compound eyes and dorsally three ocelli arranged in triangle. Antennae consist of a variable number of articles according to taxa and sometimes according to the sexes of the same species. In most Apoidea and Vespoidae, the antennae of males have 13 items and those of females 12. The most basal article is called scape, the next pedicel; the others are the flagella **(Eardley *et al.*, 2010).**

2.2 The thorax

It is formed of three welded rings, on each of them is fixed a pair of paw and two pairs of wings. The first pair is connected on the second segment and the second pair of wings on the third segment **(Jean-Prost et Le Conte, 2005)**.

2.3. The wings

They consist of a very thin and transparent membrane. The ribs are distributed consistently within the membrane and form cells (cubital, radial and discoid). The number and size of these cells form a very important criterion in the identification of families, genera and even species **(Louis, 1970)**.

The ribs of the wing of the Bee show a set consisting of a highly organized network. In addition, the hollow type with ultra-thin profile of the wings provides bees with great lightness and high speed in flight **(Louis, 1972)**. The forewings are larger and more developed than the hindwings. During the flight, the two wings are attached to each other by a hanging system consisting of about twenty hooks (hamuli), located on the anterior part of the hindwing. This system allows both wings to reduce turbulence and drag **(Le Conte, 2004; Jean-Prost et Le Conte, 2005)**.

2.3 The Legs

All bee legs consist of six items (coxa, trochanter, femur, tibia, five tarsal segments and a pair of terminal claws). In most species, the hind legs are more suitable for pollen collection because they are equipped with a pollen brush, except the Megachiles, in which the pollen brush is located under the abdomen, and the cuckoo bees (parasites) that do not have a collector brush. The shape and colour of each leg part are also widely used in determining groups of bees **(Stephen et al., 1969)**.

2.4 The abdomen

It usually consists of seven segments in the male and six in the female. It is separated from the thorax by a very fine strangulation called petiole. It contains several organs including the digestive system, reproductive system and venomous system at the end of the last segment in the female.

3 Life cycle of the bees

Like all insects undergoing complete metamorphosis, each bee's development cycle is characterized by four egg, larva, nymph, and adult stages.

According to **(Michener , 2007)**, in honeybees, it is the queen who controls sex by releasing or not releasing sperm stored in her spermatheca, fertilized eggs develop to give females, and those that are not develop to give males.

After mating, which occurs during the bridal flight, the fertilized queen returns to the hive, settles in the center of a ray and begins to deposit an egg in each alveolus following a circular movement from the center to the periphery. The egg is white, translucent, oval and has a sharper end through wuhich it adheres to the cell wall. After 3 days of incubation during which the embryo develops, a small larva hatches from the egg; its shape is arched following a slope that is pronounced as the larva grows. During the first three days, the larvae are fed porridge or royal

jelly by the nurse workers **(Biri, 2011)**. Royal larvae continue to be fed with royal porridge for the rest of their larval life, that is, for an additional 3 or 4 days. Other larvae are fed honey or pollen. By the sixth or seventh day, the larvae mature and stop eating.

The larva, before turning into a nymph, undergoes a number of moults. The nymphal stage is therefore intermediate between the larval stage and the adult stage.

The life cycle of a solitary wild bee is very simple. Upon emergence, males patrol for females and mating takes place in the immediate environment of their birth. The female will then devote most of her short existence (a few weeks at most) to making a nest in which she will accumulate pollen, nectar and other floral derivatives that will constitute the basic diet of her offspring. Some solitary bees have traded their laborious existence for a strictly parasitic lifestyle: they are called cuckoo bees **(Michez et Vereecken, 2010)**.

4 Social organization

The wild bees are mostly solitary, that is to say they do not form a complex society composed of a «royal» couple and a «court» of workers: their biology is finally quite close to most other insects, since we find a male, a female and their offspring. There are also other 'social' wild bee species, including bumblebees and halictidae **(Michez et Vereecken, 2010)**.

One of the characteristics of eusociality is the division of labour between generations. In this type of social organization, some females become functionally sterile workers.

5 The importance of the bees

The pollinator role of the bee is essential, whether it is cultivated plants whose yields interest the farmer, or wild plants whose biodiversity is preserved thanks to bees **(Benachour, 2008).**

5.1 Pollinator insect

To say how precious the honeybee is to us, it is enough to recall that a majority of flowering plants is partially or totally pollinated by it, indeed, bees are a key element of the ecosystem by its role as pollinator. **(Celli *et al.*, 2002)**.

5.2 Ecological Importance

Apoids are of great ecological importance for maintaining the diversity of native plants **(Payette, 2003)**. Without these insects, there would be no multiplication of these plants **(Rasmont, 1994)**.

5.3 Economic importance

Economically, bees play an important role in food production **(Payette, 2003)**, A study estimated the value of pollinating activity of insects, especially bees, at 153 billion euros in 2005 for the main crops on which humans feed **(Gallai *et al.*, 2009)**. According to the same authors, this value represents 9.5% of all global food production.

The honey bees has several roles:

- Role in the production of honey, propolis, royal jelly, pollen, and wax **(Bogdanov 2006).**
- Role in maintaining genetic diversity **(Anderson *et al.*, 2011; Krupke *et al.*, 2012).**
- Bees play an important role in the sustainability of agricultural activities around the world, which is partly linked to pollinating insects **(Bogdanov, 2006)**.

5.4 Biological importance

To fill his crop with 70mg of nectar, the bee sometimes has to visit more than a thousand flowers; in one hour a forager visits 600 to 900 flowers (and sometimes much more). Of the thousands and thousands of flowers it visits, the forager carries pollen grains, promoting self-pollination and allopollination. **(Toullec, 2008)**.

6 Role of bio indicator

Bees can also be used as a bio indicator of the health of the ecosystem in which they evolve. Indeed, foragers explore a large area of several square kilometers around the hive and bring back their harvest. By observing mortality and by detecting pesticide residues, heavy metals or radioactive molecules in the environment **(Toullec, 2008).**

Indeed, by its way of life and its role as a pollinator, it is submitted first to the pollutants of the ecosystem **(Amirat, 2014 et Catays, 2016).**

6.1 Role in the fight against global warming

Most trees not only herbaceous plants need pollination to reproduce. If bees disappear, because of global warming the concentration of carbon dioxide in the atmosphere could increase with disastrous consequences. Soil instability and nutrient cycling may also be affected**. (Catays, 2016) .**

7 The Bee enemies

According to **(Maréchal , 2014**), bees have many enemies that can attack adults, larvae, honey, among these enemies we can quote:

7.1 Birds

Birds feed on insects such as bees **(Belaid et Bensalem, 2020)**. They dig cavities in crates, eat bees and attack the hive's stored material **(Waring et Waring, 2012).**

7.2 Mouse

Mice can damage hives and stored materials. When bees are inactive, they generally manage to enter the occupied hive, wreaking havoc by gnawing at wood and providing nesting materials **(Waring et Waring 2012).**

7.3 Ants

Ants are generally not considered a serious nuisance to bee colonies, but the ants' attitude can stimulate bees by their movements, dirty roofs, and bee passages in the hive **(Maréchal, 2014).**

7.4 Wasps

When wasps attack honey stores in the hive, they can be a real scourge for bees. But they only look for food **(Waring et Waring, 2012)**. According to **(Maréchal, 2014)**, adult wasps enter the hive and feed on nectar, but do not despise brood larvae.

8 Bee diseases

Several deseases can affect different species of bees during her life, especialy:

- **Acariosis:** it is a parasitic disease, touches the respiratory system of the honeybee . The bees become creepy and unable to fly **(Charrière et al., 2016).** Also, causes severe physiological disorders such as blocked trachea **(Biri, 2010)**.
- **Nosémose:** is a parasitic disease due to a protozoan of the genus Nosema **(Barbançon, 2003),** develops in the digestive tract of Bees, in the middle intestine **(Barbançon, 2003).** Traces of diarrhea are observed in hives **(Adam 2012)**, reduced colony activity and weakened bees sticking to grass blades, healthy bees have a black gut, while in patients it becomes clear **(Atmane et Moucer, 2017).** A significant mortality and weakening of many bee colonies **(Scheiro, 2011)**.

- **European and American rags:** is an infectious and contagious disease of bacterial bee brood **(Fluri, 2003).** Caracterised by a mosaic brood, larvae become yellowish to brownish and sticky, release of a petrifying smell and causes colony mortality **(Atmane and Moucer, 2017)**.
- **Varroasis:** is a parasitosis due to a mite named *Varroa destructor* **(Naquet, 2011)**. The mite parasitizes the adult bee and its brood and feeds the bee haemolymph and adipose tissue **(Hummel et Feltin, 2014).**

  Results in mortality of brood and adult bees with morphological malformations, particularly in the wings **(Barbançon, 2003).**

9 The bees anatomy

9.1 Respiratory Systems

The honeybee's respiratory system starts with a row of apertures on its lateral sides known as spiracles. These holes open up into air sacs with thin walls, which lead to the tracheal system, a network of tubes. Abdominal contractions can transfer air through the system thanks to the air sacs. Thus, diffusion is the method by which oxygen is supplied to the tissues **(Snodgrass et al. 2015; Vidal-Naquet 2015).**

Figure 2: Circulatory and respiratory system**(Faux ,2021)**

9.2 Nervous System

Similar to mammals, bees have brains inside their heads, but they also have ventral nerve cords that leave the head and travel through the ventral aspects of their thorax and abdomen caudally. The ventral nerve cord is the starting point of the peripheral nervous system **(Snodgrass *et al.*, 2015).** The memory and learning abilities of honeybees are astounding. It is

incredible that foragers even bother to leave the hive every day, only to come back and share their finds with other members of the colony.

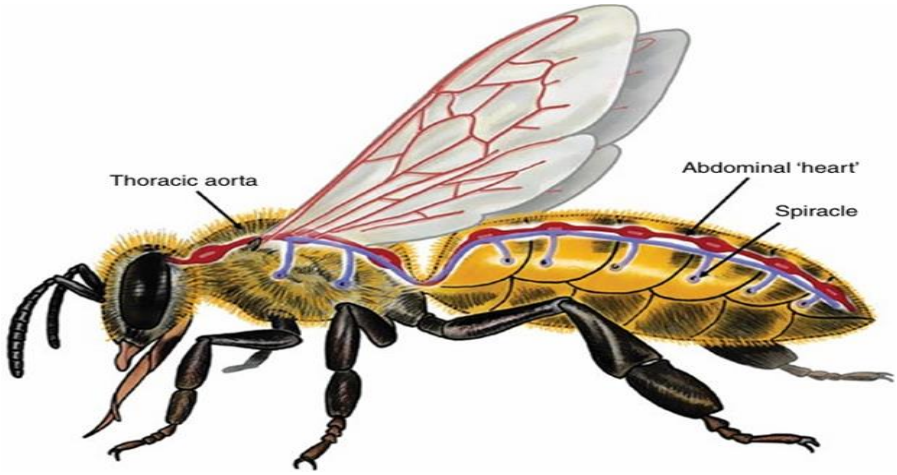

Figure 3: Ventral nerve cord of the honeybee, shown in purple **(Faux ,2021)**

9.3 Excretory and Digestive Systems

The mouth, comprising the proboscis, is the first part of the honeybee's digestive system. The lengthy esophagus empties into the crop, often known as the "honey stomach," in the cranial region of the belly after traveling through the head and thorax. When a bee consumes liquids (water, nectar, or honey) and its crop fills, the bee's abdomen enlarges dramatically **(Snodgrass *et al.*, 2015).** Resources are transported to and from the hive by means of the crop. Crop remnants are kept from moving further down the digestive canal, where the proventricular valve that sits between the crop and the ventriculus, the next section of the digestive tract, would normally break them down. The midgut, or ventriculus, is where digestion takes place.

The intestine is located distal to the midgut and consists of the rectum, a larger, expandable segment, and a short, narrow piece **(Snodgrass et al. 2015)**. Since bees normally will not poop in the hive, an expanding rectum permits feces to be held until the bee can fly out of the hive, which may take several months in the winter. Beekeepers refer them these fecal releases during pleasant weather as "cleansing flights." The Malpighian tubules, a network of lengthy, winding tubes that gather waste materials from the hemolymph and excrete them along with digestive waste through the rectum, are responsible for managing the nitrogenous waste excretion in insects. Malpighian tubules function similarly to the kidneys of vertebrates in general.

In insects, the "fat bodies" fulfill the role of the vertebrate liver. The synthesis of hemolymph proteins and the synthesis and storage of lipids are vital processes carried out by fat bodies,

which are tiny organs located on the dorsal and ventral portions of the abdomen. The honeybees' ability to survive and successfully overwinter is dependent on their fat bodies. According to a new investigation, the Varroa mite, which has the ability to completely destroy hives, feeds on the fat bodies of infected bees rather than hemolymph **(Ramsey et al. 2019).**

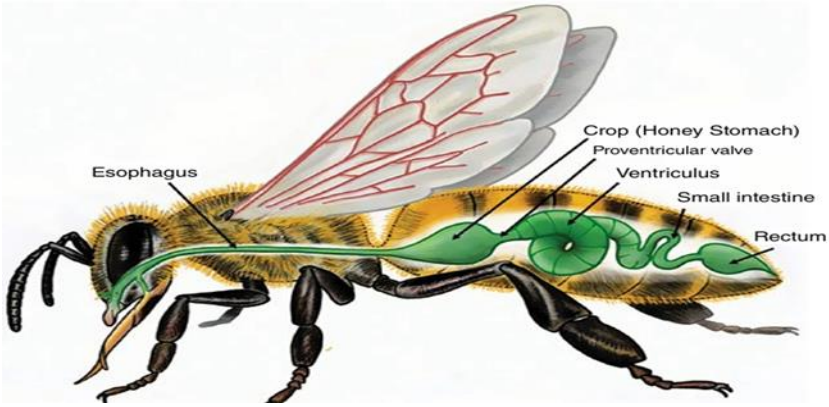

Figure 4: Digestive system **(Faux ,2021)**

9.4 Glands

In order to feed larvae, defend the hive, create comb, identify the home hive, and perform other tasks, bees have a variety of specialist glands that release substances **(Bortolotti et Costa 2014).**

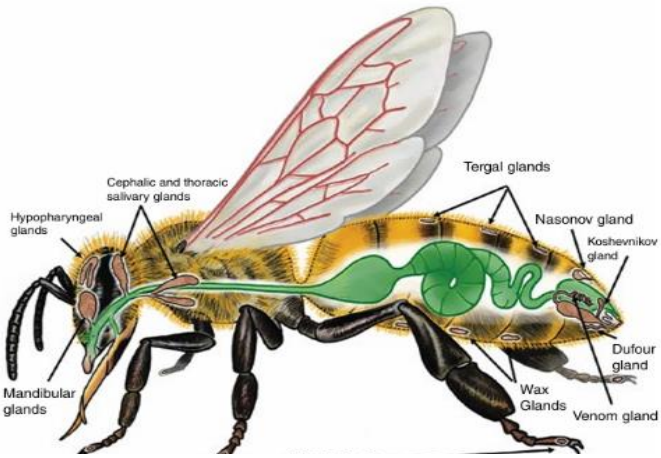

Figure 5: Overview of the glands of the honeybee **(Faux ,2021)**

9.5 System of Reproduction

The drone has all the tools needed to inseminate the queen, including an endophallus, great flying abilities, and big eyes for spotting a queen. As the endophallus separates from the drone,

spermatozoa are delivered to the queen. The drone dies during the mating process **(Vidal-Naquet, 2015)**.

The queen stores spermatozoa in a spermatotheca after receiving it from several drones. In order to fertilize the egg as it passes, the spermatotheca discharges sperm into the vagina **(Vidal-Naquet 2015).**

10 The Melliferous Plants

10.1 Definition

Melliferous flora can be defined as all plant species that exist in a given territory and are likely to be the basis of honey production. They are therefore primarily nectar-producing plants. By extension, the term melliferous flora also concerns all plants visited by bees, including plants producing pollen and honeydew **(Melin, 2011)**. Generaly, honey plants are plants visited by foraging insects including bees and nectarivorous birds **(Eon, 2011).** The notion of bee species is very close to that of honey species in its broad definition. A bee species is a bee utileaux plant because of its production of nectar, pollen, honeydew or propolis. These products may be present in isolation or together **(Melin, 2011)**.

According to **Rabiet, 1981 et 1986**, the determination of honey plants encompasses several expressions. All plants are in general, interesting for bees; they are exploited for their nectars, either for their pollens, or for both at the same time.

10.2 The categories of honey plants

Rabiet (1984) reported states that honey plants are classified into three categories:

A- Mixed plants

Are those on which bees forage nectar and pollen at the same time, this is the case of the majority of fruit trees (Apricot, Apple, Pear, Plum).

B- Nectar-bearing plants

Are those that produce nectar thanks to special organs, nectaires

C- Pollen-bearing plants

These are the plants on which bees forage only pollen as for example «Poppies, Helianthemes» The most important honey plants are those that have a high and regular nectar productivity, that exists in large stands and produces very good quality honey **(Louveaux, 1980)**.

10.3 Relation between bees and plants

The relationship between pollinating insects and honey plants is a complex system on which the success of both partners' production depends directly or indirectly. In bees and Apoids, in general. The phenomena of co-evolution have been particularly studied, between the physiology, morphology or behaviour of insect foraging on the one hand, and color, nectar production, olfactory signals of plants on the other **(François, 2012)**.

According to **Tarek et Boulemtafes (2017)**, shows that bees travel the flowers according to their colors and their productions in nectar or honeydew. These same authors, observe that 107 species and foraged of which 54 most visited either for pollen or for nectar. Also, **Sekkal (2018)**, reported that more than 360 species are foraged by bees where the yellow color dominates the flowers. It also appears that the Asteraceae family is the most representative.

The pollen composition of honeys reflects only the floristic composition surrounding the hives. In a dry environment the bee forages all the vegetation that surrounds the hive, unlike a wet where the bee selects the species to forage namely the endemic. According to the same authors, pollen from flowers that bloom 6 months before the honey harvest does not detect in honey **(Lobreau-Callen et Damblon**, **1994).**

10.4 The main melliferous plants:

In this table, we have presented the different plants used by bees in the world **(Philippe, 1994).**

Tableau I : The main nectar and pollen plants grown

Common Name	**Scientific name**
Citrus	*Citrus sp*
Almond	*Prunus anygdalus batsch*
Coffee Plants	*Coffia sp*
Canola	*Brassica napus L*
Eudicots	*Brassica campestus L*
Mustards	*Brassica alba (L) Koch* *Brassica nigra (L) Koch*
Cotton	*Grossypium sp*
Hevea	*Hevea brasiliensis*
Alfalfa	*Medicago sativa L*
Sins	*Prunus persica (L) Batch*
Poplars	*Populis sp*
Apple	*Malus Communis Mill*
Sainfoin	*Onobrychis vicia folia scop*
Soy	*Glycine max (L)*
Sunflower	*Helianthus annuus L*
Clovers	*Trifolium sp*

- Citrus fruits (the rutaceae family) include mainly oranges, mandarins and lemon trees, and are an important source of honey and pollen in the mande **(Philippe, 1994).**
- The almond tree (the Rosaceae family) produces an exquisite and clear nectar and pollen. Pear blossoms in clumps are less melliferous than apple blossoms, but provide nectar and pollen; they are very popular with bees **(Hurpin, 1978)**.
- Rapeseed (family Brassicaceae) is highly cultivated, a major melliferous resource due to stand density, abundance of nectar secretion and pollen richness **(Louveaux, 1980).**
- Sainfoin is a hardy legume. Its melliferous value is recognized everywhere. Both nectariferous and polliniferous. It provides or provides beautiful honeydew and famous honeys. **(Bocquet, 1977)**.

- A variety of sainfoin: Sainfoin from Spain is very common in some regions, especially in Kabylie where it covers large areas. It is a very abundant source of honey, which is white tinged with yellow. **(Skender, 1972)**.

Materials and methods

II. Presentation of the study area

Our research was carried out in two different ecosystem, the first station located at 1400m altitude (Djurdjura National Park, Tikjda) and the second station at 500 m altitude (Errich forest). The biotic and abiotic factors are different, such as climate, the nature of the soil and vegetation, intervene directly or indirectly on the distribution of wild bees.

1. Tikjda

The Djurdjura National Park is located in the north of Algeria about 40km south of the Mediterranean coast and 150 km east of Algiers **(Derridj, 1990)**, it occupies the territory of two Wilayas, Tizi-Ouzou (north side) and Bouira (south side) **(Figure N° 06)**. It forms a forest massif located at the level of the Tellian Atlas mountain range. This massif is divided into three parts: the eastern massif (highest point: Lalla Khedidja at 2,308 m), the central massif (highest point: Ras Timédouine at 2,305 m) and the western massif (highest point: Haizer at 2,164 m) (**Bara et Khiter, 2017**). It is composed of five antennas distributed over the peripheral area: Tizi n Koullal and Ath Ouabane and Tala Guilef for the North side, Tikjda and Tala-Rana for the south side (**Laoudj et Dadi, 2003**).

Figure 6 : PND Geographic Location Map (**PND, 2021).**

The Djurdjura National Park is a public establishment (administratively owned by two Wilaya: Bouira on the south side and Tizi-Ouzou on the north side) which covers an area of 18550 ha whose administrative framework was defined by Ministerial Decree No. 460/83 of 23 July 1983, under the supervision of the Directorate General for Forestry (DGF) and the Ministry of Agriculture and Rural Development. Since 1997 it has been classified as a biosphere reserve by the U.N.E.S.C.O. in its MAB program (Man And Bioshpere). The headquarters of the

Djurdjura National Park is located in Bouira, it is headed by a director assisted by a secretary general, heads of departments and administered by a board of orientation in accordance with Decree No. 458/83 of 23 July 1983 on the standard status of National Parks **(Laoudj and Dadi, 2003)**.

1.1. Description of the study site (Tikjda Sector)

1.1.1. Geographic location

The Tikjda sector is located west of the southern slope of the central Akouker massif of the Djurdjura chain. It is located about 30 km northeast of the capital of Bouira (Figure N° 07).

Tikjda covers an area of 3,700 ha that extends over a length of 20 km and a width that varies from 1 km (to the west) to 4 km (to the east) .

The elevation of the study site (Tikjda) is 1800 m. The Lambert coordinates of the Tikjda site are X: 625 to 629 km and Y: 347 to 352km.

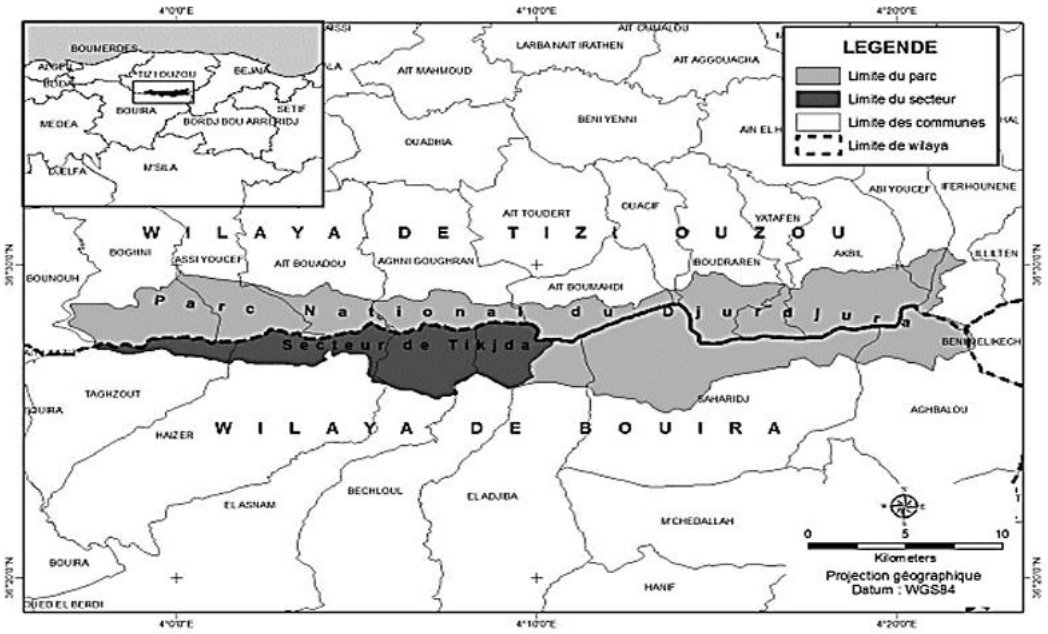

Figure 7: Location map of the Tikjda site (Djurdjura National Park) **(PND, 2014).**

1.2. Climate and bioclimate

In order to determine the climate and bioclimate of a given region, it is important to know the length of the season and all the climatic factors it undergoes, including the amount of precipitation, temperatures, wind, etc. Moreover, Tikjda does not have a weather station that would allow us to make a climate assessment, which is why we used climate data from **Derridj (1990)**. According to the same author, temperatures and precipitation were estimated from the

Bouira station and used the gradient established by **Seltzer (1946)** which recommends a reduction of 0.4°C /100m of elevation gain for the average of the minima and 0.7°C /100m for the average of the maxima.

2. Erriche forest

2.1 Description of the study site (Erriche forest)

The forest concerned by the study project called canton Errich is part of the state forest of Bouira, is located not far from the town of the chief town of the wilaya (on the northwest side), an area of 547 Has including the recreational forest Errich.

Tableau II: Geographical coordinates of Errich Township (DGF))

X1	36°24′34,78″N
X2	36°23′49,10″N
Y1	3°51′31,15″E
Y1	3°51′17,81″E

2.2. Administrative situation The Errich Township is located entirely in:

• Wilaya from: Bouira

• Daira from: Bouira

• Commune of: Bouira

• Bouira National Forest

• Location: Errich Township

Erriche forest is limited to the north by the oued djemaa and the village of Ouadhia, south by agricultural land and the town of Bouira, east through agricultural fields and Ben Mahdi village and west through the forest of Tikouka Township (Figure N° 08**)**.

Figure 8 : Situation of Errich forest **(Google earth, 2024).**

2.3. The climate framework

The study area located in the subhumid bioclimatic floor with a continental tendency, because the Djurdjura chain and the Kabyle massif cushion the influence of the Mediterranean, it is in winter season irregularly rainy and in summer season dry and hot.

2.4. Selection of study stations

As part of our investigations, we carried out fieldwork for 3 months during the spring period from April to 2024. The geographical framework of this study includes the wilaya de bouira in two stations; namely; Tikejda and Errich. Several outputs were conducted at these stations and sampling was done randomly to better cover the entire study area and to make an inventory as exhaustive as possible. The selection of study stations is based on several criteria, the main one being altitude and vegetation cover.

3. Bees sampling

During our investigations, we conducted six field trips during March, April and May 2024. The equipment used in the field is nets mowing, plastic tubes and boxes. The information for each captured specimen is recorded on a label affixed to the box.

Figure 9 : Drag net used for capturing the wild bees **(original photos)**

4. Laboratory work

The purpose of this preparation of hymenopteran species is to make visible the characters necessary for their identification and to allow an optimal conservation. The insect is then pinned with entomological pins of thicknesses proportional to the size of the insect. The pin is inserted perpendicular to the middle of the chest. Therefore, the insect is placed flat on a polystyrene plate and with the help of a flexible clamp, the front legs are positioned forward and the middle and back legs are positioned backward. The right pair of wings is spread out so that the wing cells are visible. Once the display is complete, the hymenopteran insects are left to dry for two to three days at room temperature and in a dry and ventilated place (Figure N° 10).

Figure 10 : Pinning a bee to the thorax **(original photos).**

4.1. Labeling

The labels contain the basic information on each of the preserved specimens. All taxa must be labelled and most often: capture location, date, hore and other observation (**Figure N° 11)**.

Figure 11: Bee assembly and display technique

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Results and discussions

III. Results and discussions

1. Variation of the number of bees for each station

The following figure presents the pie chart for species bee that live in two different biotopes, high and low. The first station is located in Bouira city and the second station is located in Djurdjura mountains. We can observe that the percentage of species is higher in Tikjda (63.63%) than Erriche (36.36%). This difference could be that the Djurdjura mountains represent a natural environment; rather the second station which located in an industrial environment.

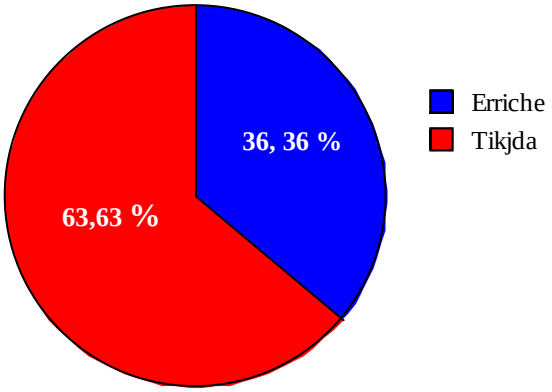

Figure 12: Pie chart for each station (Erriche and Tikjda) Cell Bar Chart, (N= 99), results presented with ES.s

2. Variation of biometric parameters of bees

2.1. Weight and legth bees

The following figures (13 and 14) showed a bar chart of the average weights and length of bees living in the two studied areas, Tikjda ad Errich, respectively.

We notice a slight increase in the weights of bees in the Tikjda area (0.12mm) compared to the weights of bees in the Erriche area (0.115mm). Therefore, the height factor does not significantly affect the weights of the bees. The following figure represents a bar chart of the total lengths of bees for each region. We note that the difference in lengths is close, with a slight increase in the Tikjda region (17 mm) compared to the Erriche region (16mm).

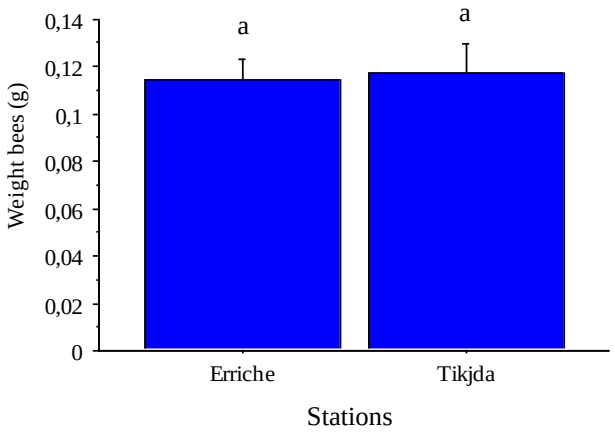

Figure 13: Bar chart showed the relationship between weight bees and stations, (N = 99), results presented with ES.

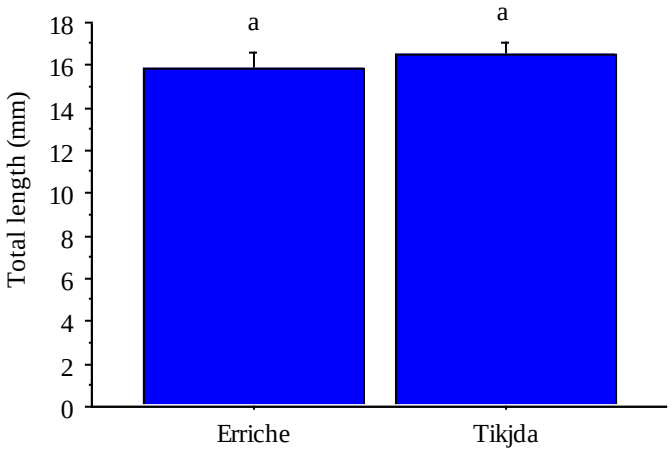

Figure 14: Bar chart showed the relationship between total length and stations of each bees (N= 99), results presented with ES.

3. Variation of different parts of bees

3.1.Fore wings length and width

This figure represent the bar chart of the FWL with the FWW for each of the two regions. We note that the difference in average length between the bees of the two regions is greater in the Tikjda region (11mm) than in Erriche (10mm). This is due to the nature of the wide mountainous region and the presence of a high-intensity air current compared to Errich region, which makes the bee more resistant to the air, its speed increases in the region.In contrast to the average width of the front wing, which is similar in the two regions (4mm).

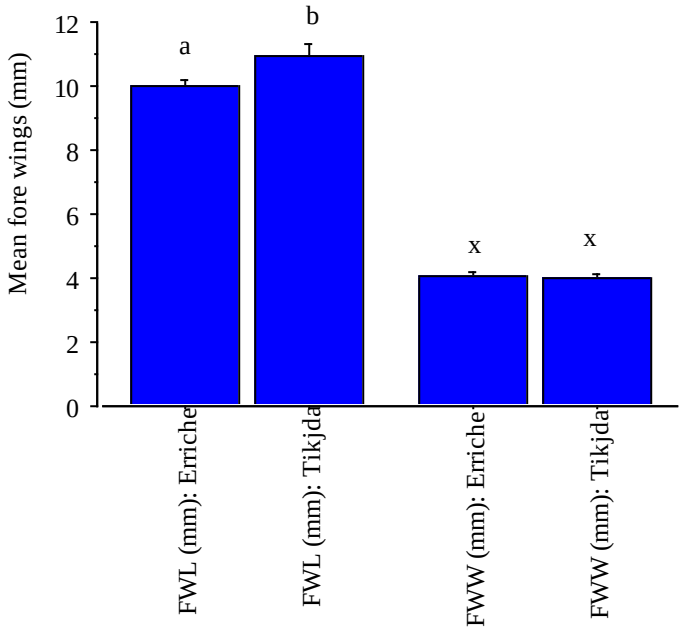

Figure 15: Bar chart showed the relationship between fore wings length (FWL) and Fore wings width (FWW) bees for each stations (N= 99), results presented with ES.

3.2. Hind Wings Length and width

The following figure represents bar chart of the HWL with the HWW for each of the two regions. We note that the difference in average length between the bees of the two regions is greater in the Erriche (7.5mm) region than in Tikjda (6.4mm) and the same observation for to the average width of the front wing in the two regions (2.7 mm) Erriche (1.7mm) Tikejda.

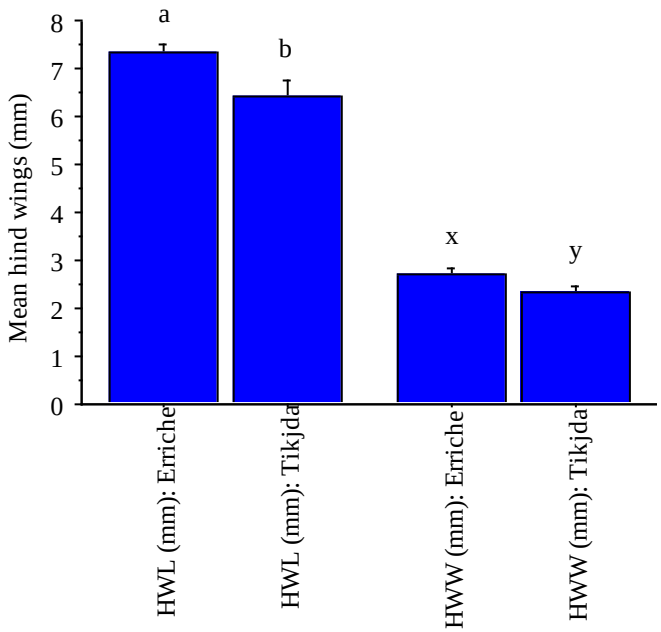

Figure 16: Bar chart showed the relationship between hind wings length (HWL) and Hind wings width (HWW) bees for each stations (N= 99), results presented with ES.

3.3. Antenna

The following figure represents bar chart of length antenna bees for each of the two regions. We can observe that the difference in average length between the bees of the two regions is greater in the Tikjda (6mm) region than in Erriche (5mm). This is due to the nature of the wide mountainous region and the presence of a high-intensity air current compared to other regions , because bees use their antennae to communicate, through them they can determine their physical environment , humidity, tastes, and give signals about the flight speed they need, which makes them longer than Erriche .

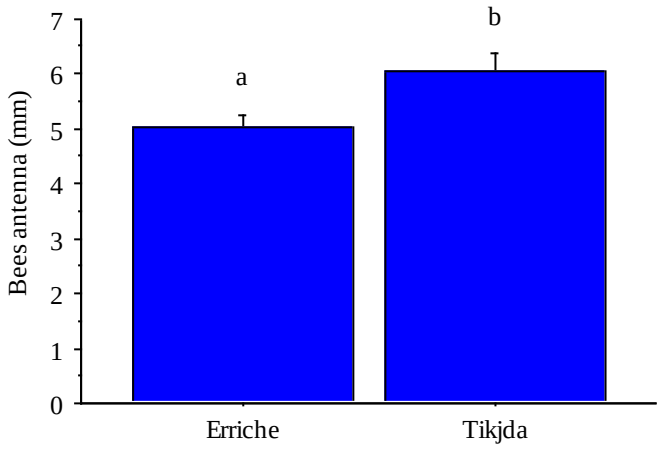

Figure 17: Bar chart showed the relationship between antenna bees for each stations (N= 99), results presented with ES.

3.4. Hind, middle and fore legs bees

The following figure represents bar chart of the hind, middle, fore length legs for each of the two regions. We note that the difference in average of the hind, middle, fore length legs between the bees of the two regions is greater in the Tikejda region than in Erriche, because they use their legs to clean their bodies and cling to flowers.

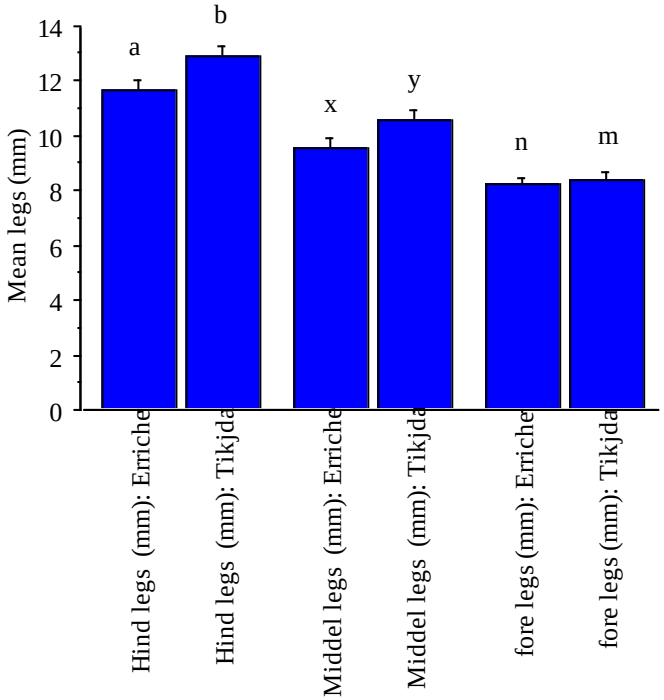

Figure 18: Bar chart showed the relationship between hind, middel, fore legs bees for each stations (N= 99), results presented with ES.

4. The number of family and gender bees in each station

4.1.Tikjda station

The bar chart represents the number of families and genders in the Tikjda region. We note that the Apidae family is the most widespread in the region, specifically the gender of *Bombus*, while the least widespread family is the Halictidae family.

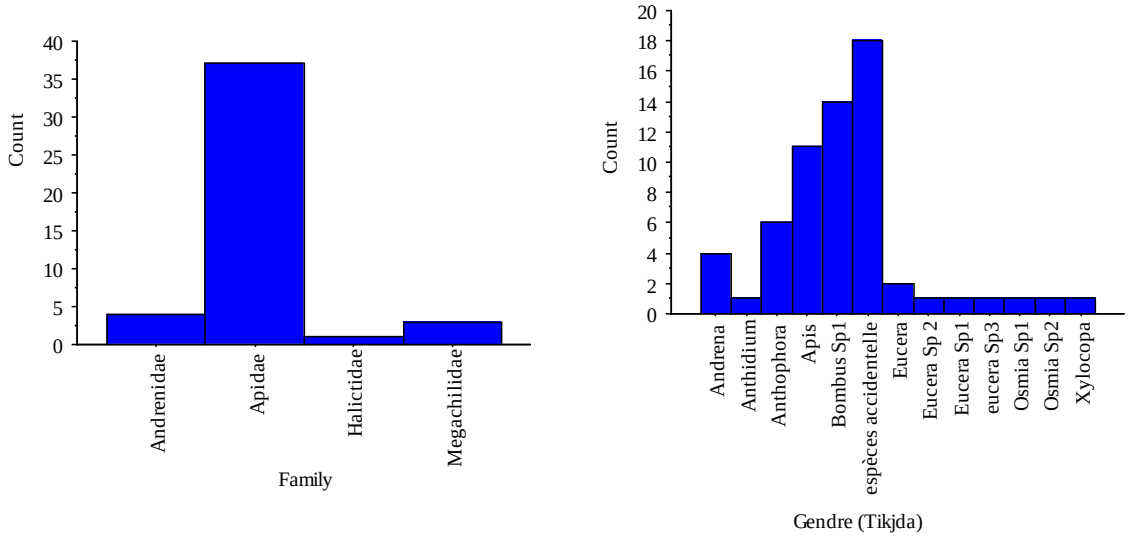

Figure 19: Bar chart showed the number of family and gender bees in Tikjda stations (N= 99), results presented with ES.

Erriche station

The bar chart represents the number of families and genders in the Erriche region. We note that the Megachilidae family is the most widespread in the region, specifically the gender of *Megachile*, while the least widespread family is the Andrenidae family specifically the gender of *Andrena*.

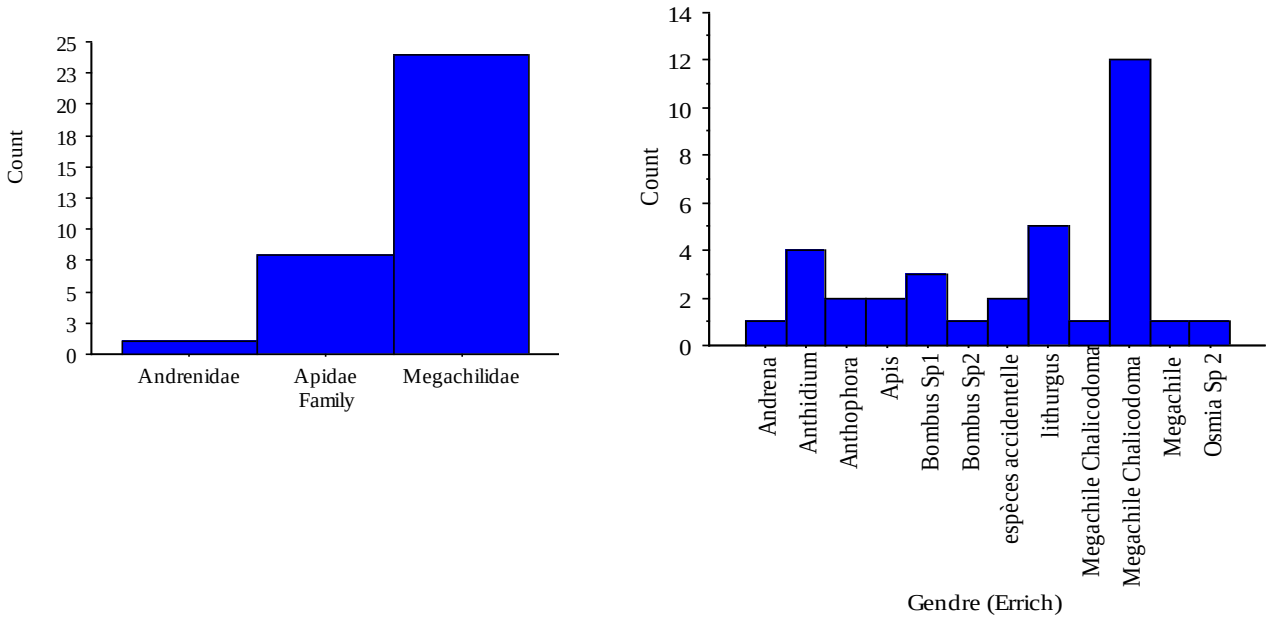

Figure 20: Bar chart showed the number of family and gender bees in Errich stations (N= 99), results presented with ES.

Conclusion

Conclusion

This researche work is the first study showed the relationship between the bee's biodversity living in two evirnments condition, an undisturbed and disturbed environment, Tikjda station and Errich forest, respectively. We clearly notice a difference in the morphology of bees in the two regions, and this is due to the difference in the environment of each region This requires more in-depth work on wild bees in terms of morphology, genetics, and even parasites. In this work, the percentage of species is higher in Tikjda (63.63%) than Erriche (36.36%). Probably this difference could be that the Djurdjura mountains represent a natural environment and the second station is located in an industrial environment. In addition, the weight and length of bees were hagher in Tikjda mountains. For wings, it is found that the difference in average length and weight of wings between the bees for two regions is greater in Tikjda than Errich. Also, the Apidae family is the most widespread in Tikjda region, specifically the gender of *Bombus*, while the least widespread family is the Halictidae family. But, the Megachilidae family is the most widespread in the Errich region, specifically the gender of *Megachile*, while the least widespread family is the Andrenidae family specifically the gender of *Andrena*. In contrast, the average length between the bees of the two regions is greater in the Erriche than Tikjda and the same observation for to the average width of the front wing.

In perspective, this study deserves to be in-depth work such as, biology, ecology and reproduction of wild bees in natral condition.

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Abstract

This work was carried out in the Bouira region at two different stations in Tekjda and Erriche on wild bees during the months of March to May 2024. Ninety-nine individuals were examined during six trips. We measured the length and width of several parts of the bee's body, weight, length, legs, wings and antennae. These different paramaters were higher in Tikjda station. Only the weight and length hind wings were greater in Errich station. This study led us to conclude that wild bees are more diverse and larger in the mountains of Tikjda than in Errish (63,63 and 36.36%, respectively). The most represented family in Tikjda is Apidae, but the Megachilidae family is the most widespread in the second region.

Key words: Wild bees; diversity; identification; Tikejda; Bouira.

Resumé

Ce travail a été réalisé au niveau de la région de Bouira (stations de Tekjda et Erriche) sur des abeilles sauvages durant les mois de mars à mai 2024. Quatre-vingt-dix-neuf individus ont été examinés au cours de six sorties. Nous avons mesuré la longueur et la largeur de plusieurs parties du corps de l'abeille, poids, longueur, pattes, ailes et antennes. Ces différents paramètres étaient plus importat à la station de Tikjda. Seuls le poids et la longueur des ailes postérieures étaient plus grands à la station d'Errich. Cette étude nous amène à conclure que les abeilles sauvages sont plus diversifiées et plus grandes dans les montagnes de Tikjda qu'à Errish (respectivement 63,63 et 36,36%). La famille la plus représentée à Tikjda est celle des Apidae, mais la famille des Megachilidae est la plus répandue dans la deuxième région.

Mots clée : Abeilles sovages; diversité; identification; Tikejda; Bouira.

الملخص

تم إجراء هذه الدراسة في منطقة البويرة في محطتين مختلفتين تيكجدة والريش على النحل البري خلال الفترة الممتدة من مارس إلى مايو 2024. وتم فحص تسعة وتسعين فردا خلال ست رحلات، قمنا بقياس طول وعرض عدة أجزاء من جسم النحلة وأرجلها وأجنحتها وقرون استشعارها ووزنها لمقارنة النتائج من لمنطقتين الأحيائيتين المختلفتين.

قادتنا هذه الدراسة إلى استنتاج أن النحل البري أكثر تنوعًا وأكبر حجمًا في جبال تيكجدة منه في الريش. الا الاجنحة الخلفية لنحل منطقة الريش أكبر من نحل منطقة تيكجدة، والعائلة الساءدة في منطقة تيكجدة هي الابيدة والميقاشيليدة في منطقة الريش.

- الكلمات المفتاحية: النحل البري؛ تنوع؛ تعرف؛ تيكجدا؛ البويرة.