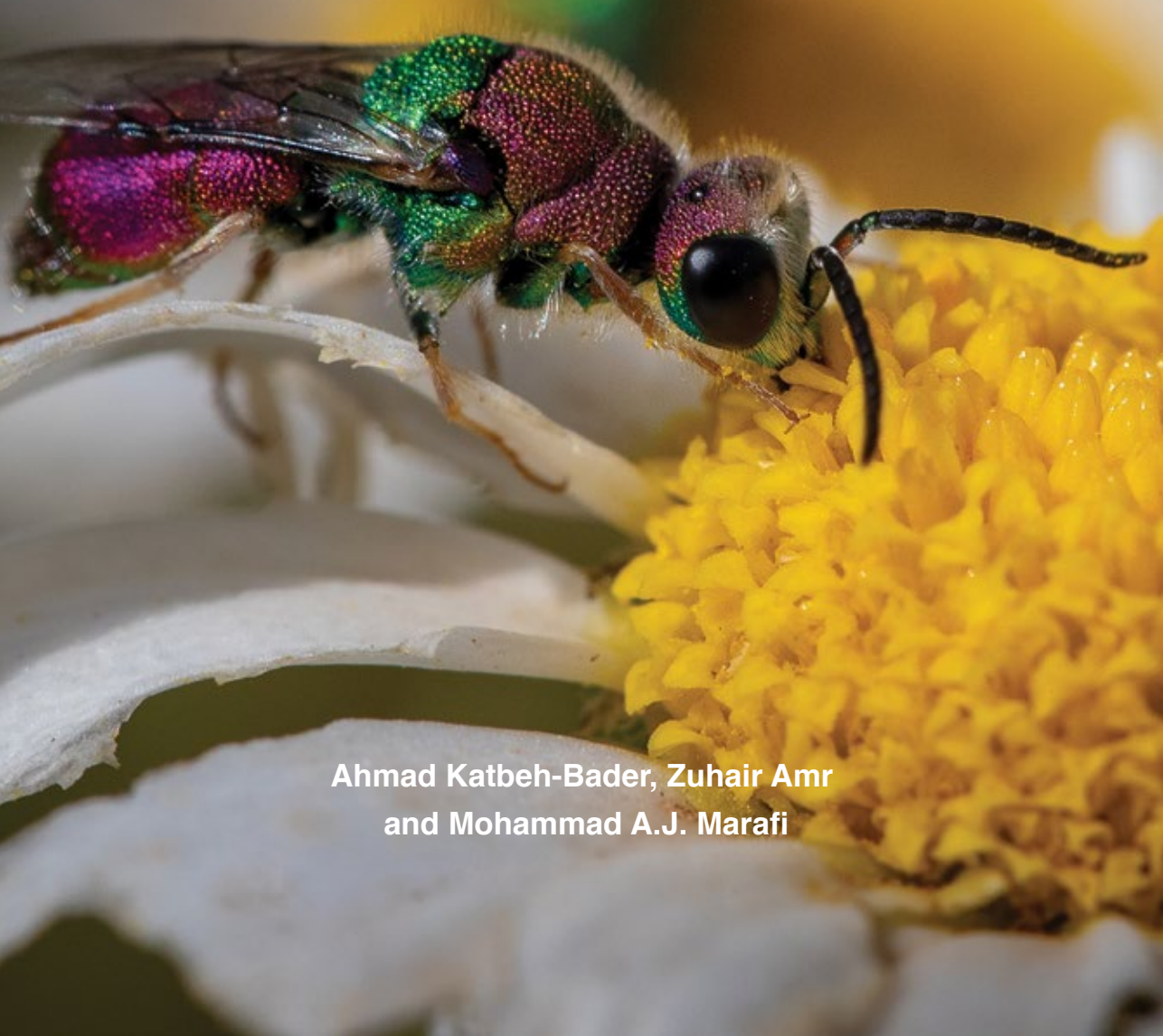
Field guide to the common insects of the State of Kuwait



Ahmad Katbeh-Bader, Zuhair Amr
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Abstract

Scientists are interested in the biodiversity of animals, plants, or other organisms. Insects constitute most of the biodiversity in the world. They have a major role in the cycle of elements in nature, a great effect on public health, sensitive environmental indicators, potential agricultural pests or beneficial insects or predators and parasitoids of pests. Collecting insects enables the entomologist to observe and record the habits and habitats of the collected insects. Methods and tools used in insect collecting depend greatly on the objectives of collecting and the target group of insects. This guide shows how to collect, kill, preserve, house and curate insect collections for scientific studies. A brief description for collecting tools and devices, how to use them, and what groups of insects may be collected by each tool are given in this guide provided with figures. All insects recorded previously in Kuwait based on publications on the insect fauna of Kuwait over the past 80 years are listed under the 19 orders: Zygentoma, Ephemeroptera, Odonata, Orthoptera, Embiidina, Dermaptera, Mantodea, Blattodea, Phthiraptera, Thysanoptera, Hemiptera, Hymenoptera, Strepsiptera, Coleoptera, Neuroptera, Trichoptera, Lepidoptera and Siphonaptera. The morphology, ecology and biology are given to these orders and their families. A total of 40 tables present lists of insect species of Kuwait.

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(Photo by Yousif Theyab)

1 Introduction

1 Introduction

Scientists are interested in the biodiversity of animals, plants, or other organisms. It has become known that every living organism has a role in nature and that if one or more species of organisms become extinct, it may lead to the extinction of a substance or compound that may be important in treating serious diseases such as cancer or AIDS. There is an urgent need to conduct scientific research on the diversity of existing species, then document, organize and finally, facilitate the exchange of such data among scientists and decision makers from different countries.

1.1 The importance of insects in the study of animal biodiversity

Although many people think that most insects are harmful organisms which must be controlled or sprayed with insecticides, the truth is the opposite of what these people believe. The following is a brief explanation on the importance of insects and their role in the environment and in the study of animal biodiversity.

1. Insects constitute most of the biodiversity in the world. About 70% of the 1.5 million species of organisms described so far are insects, and this constitutes 25 times the number of mammals, birds, and all other vertebrates. Insects and other arthropods constitute most of the animal mass on Earth.
2. Insects have an important role in the cycle of elements in nature because they are present in most nutritional levels and contribute to the decomposition of organic matter. For example, in areas rich in biodiversity, it was found that per square meter and at a depth of 15 cm there are 34,000 individuals of mites and 120,000 individuals of the order Collembola.
3. Insects have an important role in scientific research due to their ease of access, low breeding costs, small size, which can be kept and monitored in laboratories, and for their enormous diversity in form, function, behavior, methods of reproduction and adaptation in different environments. Geneticist have conducted many experiments on the small fly Drosophila which provided humanity with extensive data about all aspects of this science.
4. Some groups of insects are sensitive environmental indicators that can be considered as early warning organisms that alert us of negative environmental changes such as the effects of chemical pollution of water. There are insect species that live only in fresh and pure water, and if any pollution occurs, they begin to gradually decrease and then disappear.
5. Insects are important in studying the return of life to areas of natural disasters such as the occurrence of fires and erupted volcanoes that destroy all forms of life in the disaster area. Studies and research were conducted in Yellowstone National Park in the USA on the return of life to the area affected by the destructive fire that lasted several months.

6. Insects are of great economic importance, especially species that multiply very quickly and feed on crops to which diseases are transmitted and cause huge economic damage.
7. The impact of insects on public health is consequential, whether they are insects that annoy humans with their presence, or they are parasitize and transmit diseases to man and his domestic animals.
8. Insects are important in studying biogeography and in supporting the theory of continental drift. For example, insects that live in West Africa also live in eastern South America which proves that both continents were at once connected as one land mass.

1.2 Geographical setting

The total area of the State Kuwait is 17,818 km^2 of land and about 1,000 km^2 of offshore islands. It is situated in the most northwestern corner of the Arabian Gulf (Figure 1). Kuwait is an arid country and consists mainly of des-

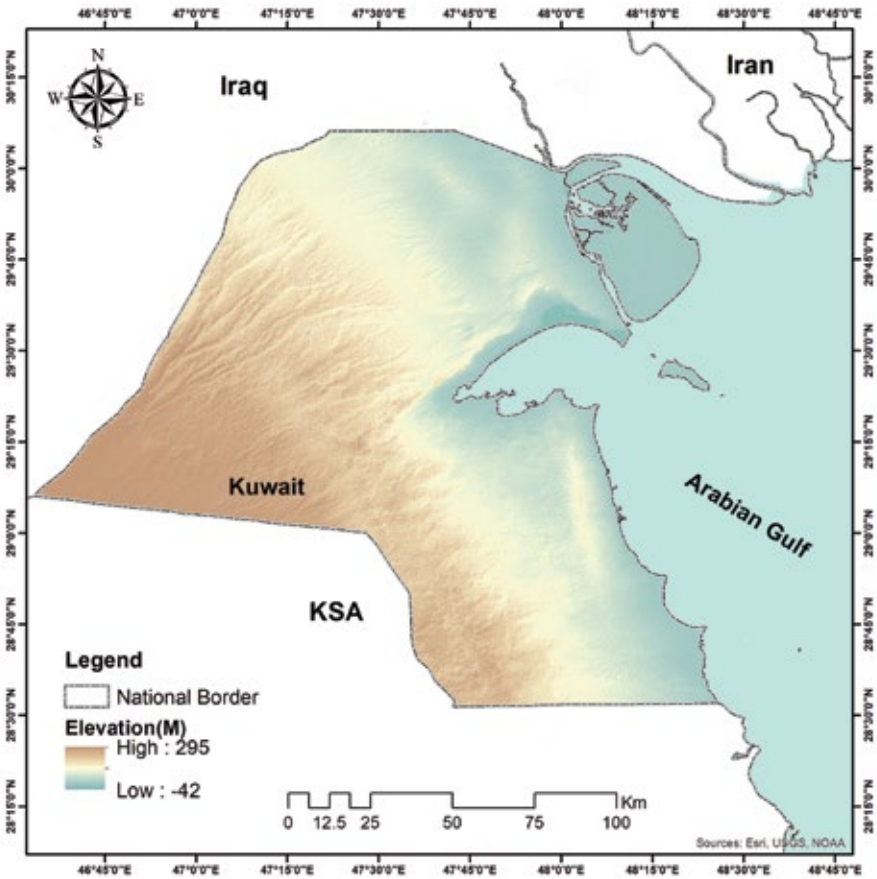

Figure 1: General map of Kuwait (Source: IUCN, H. Haddad)

ert land. It is bordered by the Kingdom of Saudi Arabia to the south and southwest and Iraq to the north and northwest.

The landscape is relatively flat, broken only by occasional low sand dunes and shallow depressions. The surface elevates gently from east to west reaching about 300 m above sea level at Al-Shigaya and Al-Salmi. The eastern part of the State, including all the inhabited area, overlook the Arabian Gulf with the coastline that extends approximately 195 km. The surface consists of flat sandy plains interspersed with some low-rise hills, some of which reach a height of nearly 145 metres. Moreover, in northern Kuwait, there are a series of hills such as the Jal Al-Zour ridge, the hills of Al-Marw and Al-Liiah. In the south, hills in the form of domes are common in the regions of Warah and Burgan. Sand dune areas are mostly located in northwestern Kuwait along the Al-Huwamiliyah-Al-Nimritayn zone reaching the Al Atraf area. Several dry desert wadi systems, such as Wadi Al-Batin, crisscross Kuwait extending along the Kuwaiti-Iraqi borders about 150 km, and runs along the western borders

Figure 2: Habitats in Kuwait **A.** Water frontier on the Arabian Gulf B. Al Jahrah Nature Reserve C. Idrea'. **D.** The Jal Al-Zour Ridge **E.** Al Hewysat **F.** Um Al Rimam (Photos by A. Alenezi).

of Kuwait, with a width in some parts reaching about 10 km and a maximum depth of about 57 metres. To the north lies the Rawdatain Plain, consisting of flat land that slopes towards the east and the northeast (Figure 2).

Kuwait contains nine islands in the Arabian Gulf, the largest is being Bubiyan Island (683 km^2). The coastal strip extends for about 500 km, with numerous small bays and lagoons. The two largest bays are Kuwait and Kazma. Several lagoons such as Abdullah, Boubyan, and Al Subiya Khawrs are located in the north, and Al Maftah and Al Maftah and Al Amma Khawrs in the south (Amr et al., 2021).

(Photo by Jasem Almotar)

2 Insect collecting and preservation

2. Insect collecting and preservation

2.1 Collecting

Insects are a diverse group of animals with about one million described species worldwide. They live in a variety of terrestrial and aquatic habitats. They may be found on or below soil, on plant leaves, flowers, fruits, roots, on or inside animals, humans, or other insects. Most insect have wings and fly either during the day or at night. Therefore, collecting insects requires different tools and techniques. Insect collecting is needed for establishing insect collections or insect museums, biodiversity evaluation studies, ecological studies and for teaching entomology courses. Collecting insects enables the entomologist to observe and record the habits and habitats of the collected insects. Methods and tools used in insect collecting depend greatly on the objectives of collecting and the target group of insects. This guide is meant to be used by insect collectors, and includes the tools and equipment needed in insect collecting with brief descriptions for these tools and how they are used. Most of the data depended on an online updated version of “Collecting and Preserving Insects and Mites: Techniques and Tools” by Schauff (1986) and on chapter 35 in Borror and Delong’s Introduction to the Study of Insects, 7th Edition (Borror et al., 2005).

2.1.1 Collecting bag

The following tools are generally placed in a collecting bag (Figure 3) which sould facilitate insect collecting in the field. It may be purchased, or hand made. It may contain all or most of the following tools:

- a10X hand lens
- a fine brush for picking up minute specimens after moistening the tip with alcohol or water
- a Swiss knife or pruning scissors for extracting insects from leaf or twig galls
- an aspirator for collecting small, soft, or fragile specimens
- forceps- featherweight forceps are recommended in order not to squash the insect
- genitalia capsules for keeping very small insects
- killing jars containing potassium or sodium cyanide, or ethyl acetate
- papers and pencil for writing temporary labels, and scissors for cutting labels
- plastic or paper bags collecting infested plant parts
- small Odonata envelopes for temporary storage of butterflies or dragon flies

- vials containing 75% alcohol for collecting small insects or arthropods
- GPS device- amobile phone may be sufficient if it is equipped with GPS

Figure 3: Collecting bag (Photo by: BioQuip Products, Inc.).

2.1.2 Collecting nets

Different types of collecting nets may be used depending on the target group of insects.

Aerial or butterfly nets

Aerial or Butterfly nets (Figure 4) are used for collecting butterflies, moths, dragonflies, damselflies, and other flying insects. Homemade nets can be easily made with a rim diameter of 15-40 cm.

Sweeping nets

A sweeping net (Figure 5) is made of strong cloth that can withstand friction with rough plants or spines. It is used to sweep spiny shrubs for collecting leaf or plant hoppers and other small insects.

Collection of flying insects is achieved by swinging the net rapidly to cap-

Figure 4: Butterfly net (Photo by: BioQuip Products, Inc.).

Figure 5: Sweeping nets (Photo by: BioQuip Products, Inc.).

ture the specimen thus forcing the insect to the bottom of the net. After collecting the specimen, place the tip of the net, with the trapped insects, in the killing jar for a few minutes, afterwards remove them and place them in an empty jar. Using forceps to remove stinging insects is useful in case insects are still alive.

For insects that stand on soil surfaces, like grasshoppers, use a downward stroke, holding the end of the net up so that insects will fly or walk upwards onto the net, then flip the rim over to entrap them.

Aquatic nets

Aquatic nets (Figure 6) are usually D-shaped with a strong wire and a metal handle to resist the water flow.

Figure 6: Aquatic net (Photo by: BioQuip Products, Inc).

To collect aquatic insects from a stream, place the net in the stream and disturb the water approximately 1-2 m in front of the net so that the running water will carry the agitated insects and other debris into the aquatic net. Empty the contents of the net into a light-coloured pan. Wait for few minutes until particles settle at the bottom of the pan and water becomes clear. With forceps or a dropper, pick up any insects that may be swimming (beetles, mayflies, dragonfly larvae, fly larvae…) and place the specimens in vials containing 75% alcohol.

2.1.3 Killing jars

A killing jar is made of glass with a tight-fitting metal screw top. The killing agent may be liquid or solid. Liquid agents are slower in killing but safer to

humans than solid agents such as potassium or sodium cyanide. However, some liquid agents may accumulate in human tissue after prolonged exposure. Potassium or sodium cyanide are extremely toxic to humans but do not accumulate in human tissues. It is highly advisable not to inhale the fumes while opening the jar. The killing jars should be labeled with “POISON” or skull and cross bones sign and should be kept away from children.

2.1.4 Liquid killing agents

All liquid killing agents are extremely volatile and flammable and should be used with proper care. The following liquid killing agents may be used that differ in efficacy in killing insects and safety for humans:

- Ethyl acetate (CH3CO2 • C2H5): Ethyl acetate is most widely used because it is effective and less toxic to humans.
- Ether (diethyl ether, C2H5 • O •C2H5)
- Chloroform (CHCl3)
- Ammonia water (NH4OH solution): Although it is irritating to humans, it may be used in light traps and in keeping small moths in vials as it keeps the specimens soft and relaxed.

Ethyl Alcohol (ethanol or ETOH) or Isopropyl alcohol may be used to kill beetles and weevils (Coleoptera), small bees and wasps (Hymenoptera), and many insect larvae and soft-bodied insects.

Killing jars with liquid killing agents can be prepared by pouring approximately 2-3 cm of plaster of Paris mixed with water into the bottom of the jar. After the plaster dries, the killing agent should be added to saturate the plaster and excess liquid should be poured out. The liquid killing agent should be monitored and replenished, as it dries up from frequent use.

Another method of making liquid killing jars is by placing cotton or paper tissues at the bottom of the jar and covering them with a cardboard or a paper cut to fit the circumference of the jar to slow the evaporation of the liquid and to prevent the insect from being entangle with the cotton.

2.1.5 Solid killing agents

Solid killing agents are used in killing jars in which they transform from solid state to the gaseous state which is toxic to the insect. All solid killing agents are dangerous poisons with no known antidote, and extreme care should be considered in handling and using them. In some countries, a security clearance should be obtained when purchasing these materials. Any of the following solid killing agents may be used in killing jars:

- Potassium cyanide (KCN): This is the best and most used killing agents in killing jar preparation.
- Sodium cyanide (NaCN): A disadvantage of this material is that it makes the jar wet, thus affecting the quality of the collected insect

especially hairy or scaly insects.
- Calcium cyanide [Ca (CN)2]. This agent is difficult to obtain.

The cyanide killing jar is made by placing a layer of 1-2 cm of cyanide crystals in the bottom of the jar. Then, this layer is covered with about 1 cm of sawdust and after that, approximately 1cm of plaster of Paris is placed after being mixed with water to form a thick paste. A tissue paper is placed at the top of the plaster to prevent water condensation on the inside glass surface. The jar will be ready for use after several hours. All killing jars should be labeled with “POISON”. The bottom must be covered with strong tape to prevent the scattering of the cyanide crystals if the glass beaks. Cyanide killing jars should be prepared under fume hood because they should remain open for several hours until the plaster of Paris totally dries.

Important recommendations for the optimum and safe use of the killing jars

- Never test a killing jar by smelling its contents.
- Dispose of old killing jars by burning or burying.
- Place wrinkled tissue paper in the killing jar to prevent liquids coming out from dying insects to each other and to prevent them from destroying each other. Replace tissue paper if it becomes moist or dirty.
- Do not place jars in direct sunlight because they will sweat and lose their killing power.
- Frequently wipe off condensed moisture accumulated in the jar.
- Use separate jars for delicate specimens so that jumping insects such as grasshoppers, locust or large beetles, will not destroy them before they die.
- Use separate jars for moths or butterflies as scales from moths or butterflies reduce the quality of other insects in the killing jar.
- Do not accumulate many specimens in a jar because they will damage each other and reduce the quality of the specimens.
- Remove insects from the cyanide jars as soon as possible after they die because they become brittle and difficult to relax. Yellow colour of wasps and bees may change to red if specimens remain in the jar for many hours.

2.1.6 Aspirators

A small suction device is called aspirator: which is used for collecting small insects and mites that otherwise would be destroyed by forceps or fingers (Figure 7). The needed parts to make an aspirator are:

- a vial 2.5-5 cm in diameter and about 12 cm long
- two pieces of glass or copper tubing about 7 mm in diameter, one piece about 8 cm long and the other about 13 cm long
- a rubber stopper with two holes

- a piece of flexible rubber or plastic tubing about 1 m long, with a diameter just large enough to fit snugly over one end of the shorter piece of stiff tubing
- a small piece of cloth mesh, such as cheesecloth, and a rubberband

Figure 7: Aspirator used for collecting small insects by suction (Photo by: BioQuip Products, Inc).

The insects are collected and trapped in the vial by a process of suction. Ants should not be collected by sucking because they will produce formic acid which irritates the lungs. An alternative way is to use an aspirator that depends on blowing air (Figure 8) rather than sucking air which will prevent inhaling small particles, fungus spores, or harmful fumes.

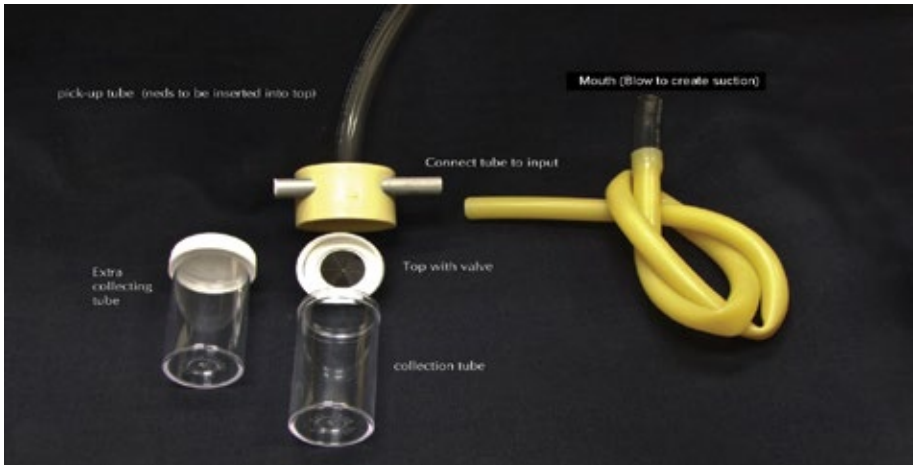

Figure 8: Blowing aspirator collects insect by blowing rather than sucking to avoid inhaling toxic materials (Photo by: BioQuip Products, Inc).

2.1.7 Suction devices

2.1.7.1 InsectaZooka field aspirator

This is a lightweight, compact and portable field aspirator (Figure 9). Different suction levels can be used. It can be used for collecting insects from plants, grasses, shrubs and lawns or for medically important insects much as mosquitoes. It operates on 12 VDC. A male cigarette plug adapter is also provided for connection directly into a female battery plug. Two bungee cords are used to secure the tubing sections to each other and to the drive unit. The collecting tube can be removed and placed on the exhaust port to create a blower. Clear polypropylene collection cups are placed at the end of the tube to trap insects into them.

Figure 9: InsectaZooka field aspirator (Photo by: BioQuip Products, Inc).

2.1.7.2 Handheld collecting device

Typically, this device is a modification of portable vacuum cleaners sold at markets (Figure 10). It uses rechargeable batteries that provides approx-

Figure 10: Handheld collecting device (Photo by: BioQuip Products, Inc.).

imately 15 minutes of suction time in the field. The modification involves the placement of a clear acrylic tube nose with a removable collecting chamber which is 12.7 cm long x 5.1 cm in diameter. The chamber has an aluminum screen across one end for air flow, and a flap valve on the other. A supplemental end cap prevents the escape of specimens when chamber is removed. Live insect can be collected from different habitats using different chambers. Suction strength can be adjusted using the vacums's air-bleed ring.

2.1.7.3 Backpack aspirator

This device was developed by the U.S. Public Health Service to collect adult resting mosquitoes (Figure 11). However, it can also be used in collect-

Figure 11: Backpack aspirator, a powerful tool for collecting insects from different habitats (Photo by: BioQuip Products, Inc).

ing other insects from weeds, shrubs, trees, lawns in large numbers since it is more powerful that the previous handheld devices.

2.1.8 Beating sheets

A beating sheet is made of white cloth attached to a 1 m x 1 m wooden frame with two supporting crossing sticks (Figure 12). A light-coloured umbrella may also work as an alternative.

Figure 12: Beating sheet (Photo by: BioQuip Products, Inc).

Place the beating sheet or the umbrella under a tree or shrub twigs and shake or beat the branches with a stick. Locate fallen insect such as beetles and weevil, plant bugs, leafhoppers and moth and butterfly larvae by observing any movement among other fallen material. After that, collect small insects or mites with aspirator or a wet fine brush, and the larger ones using forceps. Beating is an effective collecting technique especially used during cold weather or early and late hours of the day.

2.1.9 Sifters

Insects and mites living or hibernating in ground litter, leaf mold, rotting wood, and shore detritus can be collected by sifters (Figure 13). Sifters mesh size depends on the size of the target specimens. An effective way is to use a series of sifters of different sizes arranged from the coarse sieve to the fine sieve in the bottom. Insects with the same size range will be collected in one of the sieves.

Figure 13: German-made litter reducer (Photo by: BioQuip Products, Inc).

2.1.10 The Berlese funnel

The Berlese funnel (Figure 14) separates insects and mites from leaf mold and similar materials. The sample of leaves is placed on a screen near the top of a funnel. A light bulb can be placed above the sample to produce enough heat and lightto drive the insects downward into the funnel which is placed above a container with alcohol.

Figure 14: Berlese funnel, used to collect small insects from leaf litter (Photo by: Bio-Quip Products, Inc.).

2.1.11 Photoeclector or Winkler/Moczarski elector

If no light bulb is available to drive the insect to the bottom, an open jar, with a moist cloth inside, may be attached to the bottom of a funnel. The insects will be attracted to the light and humidity. This method can be used in the field where no electricity is available.

2.1.12 Traps

Different kinds of traps have various purposes and designs. The efficiency of a trap in capturing insects or mites depends on the design, elevation from the ground or sea level, location in an area, season, weather (wind speed and temperature) and use attractants.

Windowpane traps

This kind of trap is used to intercept flying insects except butterflies. It is made of a windowpane held upright above a container filled with water with a small amount of soap to break the surface tension of the water and to temporarily preserve the caught insects. The caught specimens should be removed, washed, and preserved in alcohol or dried and pinned.

Malaise traps

This trap was originally developed by the Swedish entomologist René Malaise, and several modifications were made to the original design. It mainly consists of a vertical net serving as a baffle, end nets, and a sloping canopy leading up to a collecting jar (Figure 15).

Figure 15: Malaise traps (Photo by: BioQuip Products, Inc).

Pitfall and dish traps

This trap consists of a cup, a can, a jar or a dish sunk in the earth. A cover must be placed over the trap to reduce attractant evaporation or prevent rain from soaking the trapped insects. The cover may be a piece of wood, or a flat stone. Vinegar may be used as an attractant. Insects should be removed as soon as possible to obtain the highest quality specimens.

Yellow pan trap

A yellow plastic container may be placed on soil surface or partially buried; water is added with some drops of soap to beak the surface tension of water. Different colours usually attract different insects, but yellow generally attracts the widest range of insects, and it is the most used colour for yellow pan traps.

Sticky traps

Sticky traps (Figure 16), mainly yellow (or even other colours), may be hung near plants or on plants to catch flying insects. This method is good for quantitative studies since the collected specimens can be recorded per day or week. A disadvantage of this collecting method is that the quality of the specimens is not good, and the extraction of the specimens needs special solvents, effort and time.

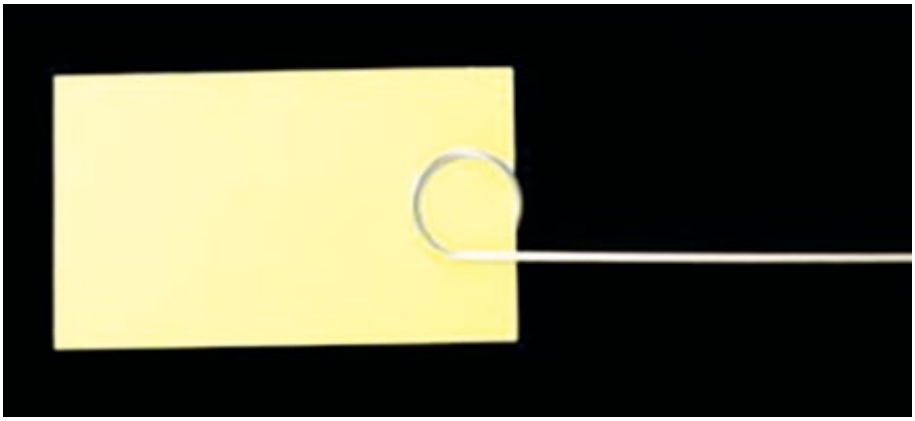

Figure 16: Yellow sticky trap (Photo by: BioQuip Products, Inc).

Butterfly and moth traps

A butterfly trap is made of an inverted cone which is placed at the bottom of a cylinder made of cloth. The trap is usually hung on a tree branch or placed on the ground. butterfly bait trap cone type and pop-up butterfly bait trap are shown in Figure 17. The attractant which may fermented fruits, such as bananas, is placed under the cone and attracted butterflies or moths are trapped above the cone. They may be collected alive or killed by a killing jar.

Figures 17: Butterfly bait trap cone (L), pop-up butterfly bait trap (R). (Photos by: Bio-Quip Products, Inc).

Light traps

Various designs for light traps are available. Basically, a light trap consists of a light source, glass or plastic baffle, a container, and a killing jar (Figure 18).

Light sheets

A light source can be placed in front of a white sheet (Figure 19). All or selected insects attracted to the sheet can be collected and placed in a killing jar or vial containing alcohol. An advantage to this method is that the specimens are soft, fresh, not damaged, and can easily be relaxed for pining.

The Oatmeal trail

In this method, oatmeal is placed on soil surface for a distance of 50-100 m. Insects that feed on oatmeal during the night are handpicked with the aid of a flashlight.

Figure 18: Light trap (Photo by: Bio-Quip Products, Inc).

2.2 Specimen preservation

Collected specimens must be preserved till the time of identification or permanently in a collection or museum. Various techniques may be used in which specimens are preserved dry after pinning or preserved in liquid.

Figure 19: Light sheets (Photo by: Bio-Quip Products, Inc).

2.2.1 Liquid agents for killing and preserving

Alcohol (Ethanol)

Ethanol: 70-80% is usually the best general killing and preserving agent for most insects.

Ethanol: 50-60% is better for soft insects (aphids, thrips, small flies) or mites.

Ethanol: 90% Parasitic Hymenoptera for preserving a large number of insects in a small container since the insect fluids will dilute the alcohol.

Adult moths, butterflies, mosquitoes, and other hairy or scaly insects should not be preserved in alcohol.

Isopropanol (isopropyl alcohol): If ethanol is not obtainable, isopropyl alcohol may be used.

Hot water

Larvae of Lepidoptera and Coleoptera may be killed in boiling water for few minutes (depending on the size of the larva) to relax the specimens and to prevent colour change (usually darkening of light specimens). Following, larvae should be preserved in 70–80% alcohol.

Alcoholglycerin-acetic acid (AGA): Thrips and most mites should be collected in an alcoholglycerin-acetic acid (AGA) solution.

Kerosene-acetic acid-dioxane (KAAD): For many larvae, a kerosene-acetic acid-dioxane (KAAD) solution is preferred. If KAAD is used, larvae need not be killed in boiling water. Formulas for these and other solutions are given in the Appendix of this report.

2.2.2 Temporary storage of specimens

Refrigeration and freezing

Large insects can be preserved in a refrigerator for several days while smaller insects for one day. Afilter paper should be used to prevent water

condensation in the container. Specimens may be kept in alcohol and then in the freezer to avoid the deterioration of specimens if kept in alcohol without freezing. Insects may be kept in the freezer for years, and then preserved dry if needed.

2.2.3 Odonata or glassine envelopes

This method of preservation is achieved by placing specimens with their wings folded together dorsally in folded paper triangles or in small glassine-paper rectangular envelopes (Figures 20, 21, 22, 23). Insects from Lepidoptera,

Figure 20: Clear Odonata envelopes – can be closed by stapling, folding or heat sealing (Photo by: BioQuip Products, Inc.).

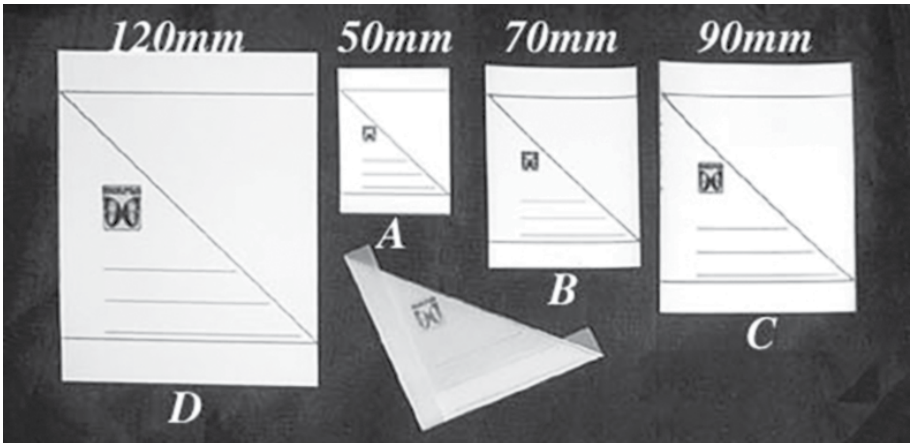

Figure 21: Lepidoptera triangles: The lines indicate how the triangles are best folded (Photo by: BioQuip Products, Inc).

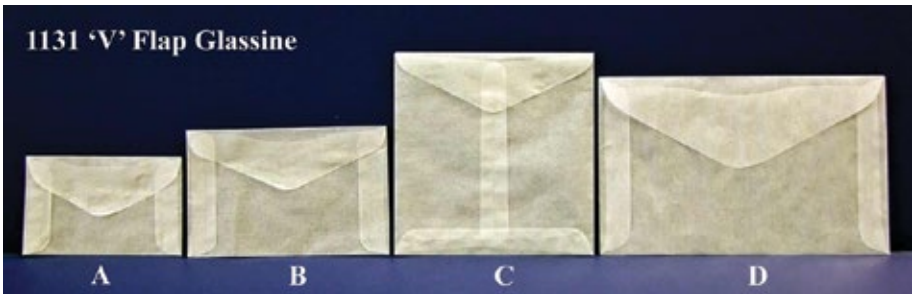

Figure 22: Flap glassine envelopes (Photo by: BioQuip Products, Inc).

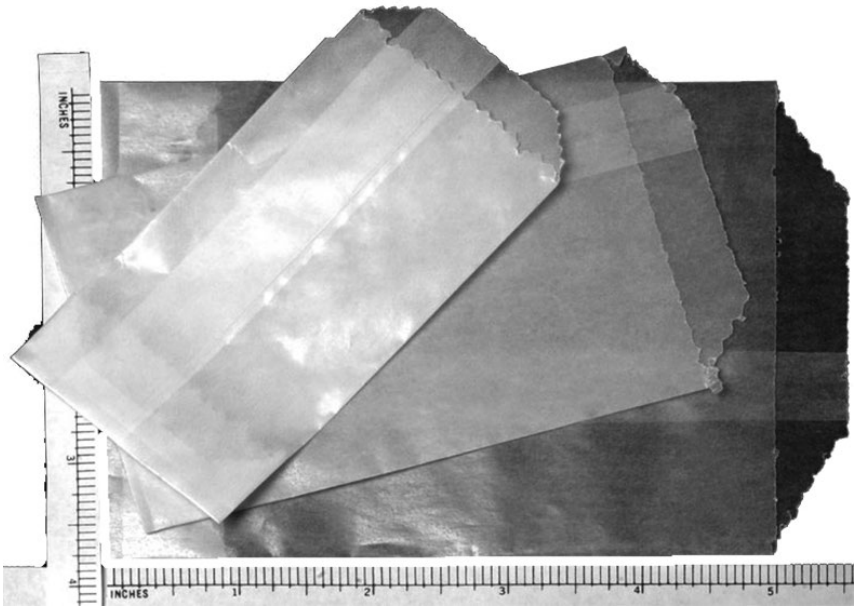

Figure 23: End opening glassine envelopes (Photo by: BioQuip Products, Inc).

Trichoptera, Neuroptera, Odonata, can be preserved with this method, and which saves a lot of space in museums. An advantage is that if head, legs, or other parts fall off, they can be examined. Label data can be written on one side of the paper bag or the envelope.

2.2.4 Liquid preservation

The best preservation fluid is ethanol 75%. Distilled water should be used for diluting the alcohol.

Label paper placed in alcohol should be high quality rag or linen and acid-free. The most durable labeling ink is India ink. Laser printed labels are not recommended.

Many vials plugged by cotton or with polyethylene stoppers can be kept in large jars filled with ethanol. Cork, rubber, or neoprene toppers tend to degrade and leach chemicals into the alcohol. Each vial should be individually labelled with collection data.

Place paper towel in the bottom of each jar to avoid glass-glass contact. Jars should be checked periodically and add alcohol if necessary. Jars should be kept away from light or vibrations.

2.2.5 Preservation for molecular studies

If molecular studies should be carried out to identify specimens, it is highly recommended they be placed in absolute alcohol as soon as they are collected or in deep freezing (-80°C). Cuticular hydrocarbons can be studied on specimens dried and pinned in museum collections.

2.2.6 Mounting specimens

Equipment needed to mount specimens are forceps, pinning blocks, pins, paper points, scissor, glue, and specimen holder (Figure 24). A plier-type pinning forceps (Figure 25) is used to insert specimens mounted on delicate pins

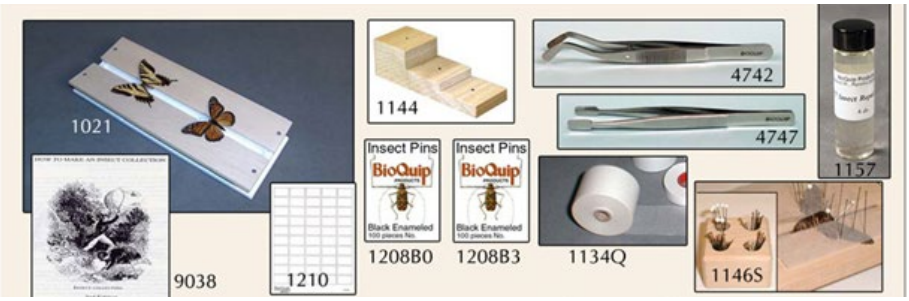

Figure 24: Insect mounting kit (Photo by: BioQuip Products, Inc).

Figure 25: Plier-type pinning forceps (Photo by: BioQuip Products, Inc).

in crock-bottomed insect boxes or to insert thin pins in hard beetle elytron that would otherwise bend. The butterfly forceps have flattened tips to manipulate the delicate wings of butterflies or moths Figure 26.

Figure 26: Butterfly forceps (Photo by: BioQuip Products, Inc).

2.2.7 Preparing dry specimens for mounting

Dry specimens such as butterflies should be relaxed by moistening them for 8 hours up to 3 days depending on the size of the specimen. The specimens should not get wet otherwise they will mold. Specimens should be placed in a tightly sealed container that contains water. However, insect should be placed on filter paper, and thymol may be added to the water to prevent mold. Naphthalene, paradichlorobenzene, phenol, or chlorocresol may be sprinkled at the bottom of the relaxing chamber to prevent molding.

2.2.8 Direct pinning

Different sizes between 000-7 of black or stainless-steel insect pins are used. The most commonly used pin size is number 2. The very fine ones are used for delicate slim insects while numbers 6 or 7 are used for very large specimens such as beetles or moths.

For large insects, the pin is placed according to the insect group as follows:

Orthoptera (grasshoppers and locust): Pin through back of thorax to right of midline. For display purposes, one pair of wings or both may be spread.

Heteroptera (bugs): Pin through triangular scutellum to right of midline. Do not spread wings. In Reduviidae, Coreidae, and other slender forms, pin through back of prothorax to right of midline.

Hymenoptera and **Diptera**: Pin through thorax between or a bit behind base of forewings and to right of midline.

Coleoptera (Beetles and weevils): Pin through right wing cover near base such that the pin exits through the metathorax (between the middle and hind legs). Do not spread wings.

Lepidoptera and **Odonata**: Pin through middle of thorax at thickest point or just behind base of forewings.

2.2.9 Double mounts

Small insects, such as mosquitos, small flies or wasps, may be pinned on

minuten pins, then placed on a small piece of cork which is positioned on a regular insect pin.

2.2.10 Mounting on cards or small triangles

Certain small insects for example beetles, wasps and flies may be mounted on a small-sized triangle as (Figure 27). Such a triangle can be made by using point card punchers as shown in (Figure 28). Other larger specimens may be placed on a rectangular card or on glue boards (Figure 29).

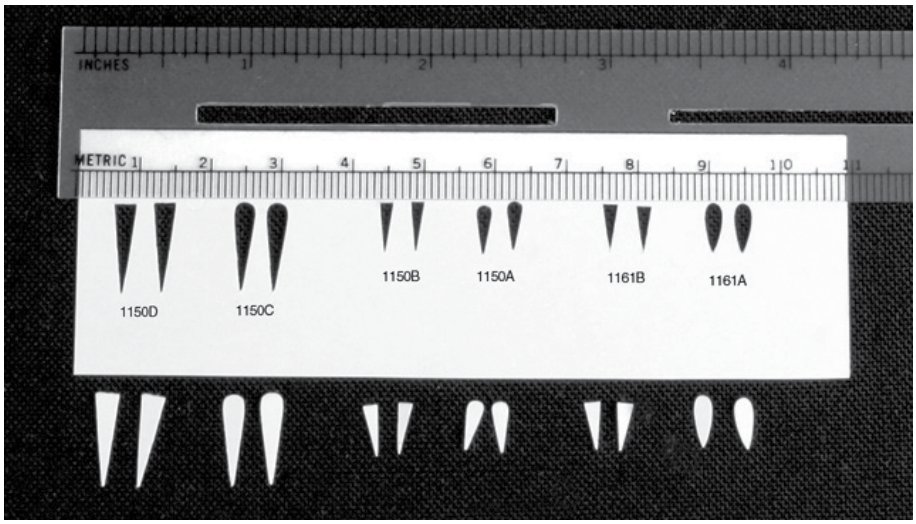

Figure 27: Point cards or triangles (Photo by: BioQuip Products, Inc).

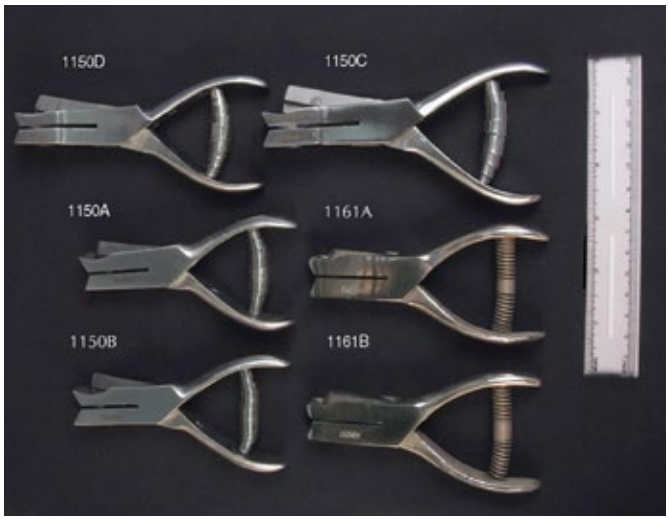

Figure 28: Point card punchers (Photo by: BioQuip Products, Inc).

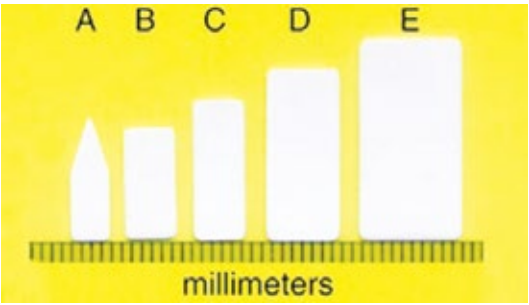

Figure 29: Cards and glue boards (Photo by: BioQuip Products, Inc).

2.2.11 Spreading boards

Different kinds of spreading boards may be used. Some of the boards have adjustable distance between the two sides (Figure 30) so that specimens with variable body width can be pinned. Polystyrene pining boards with variable diameter grooves can be purchased or handmade (Figure 31).

Figure 30: Adjustable spreadingboards (L) and fixed pinning block (R) (Photo by: BioQuip Products, Inc).

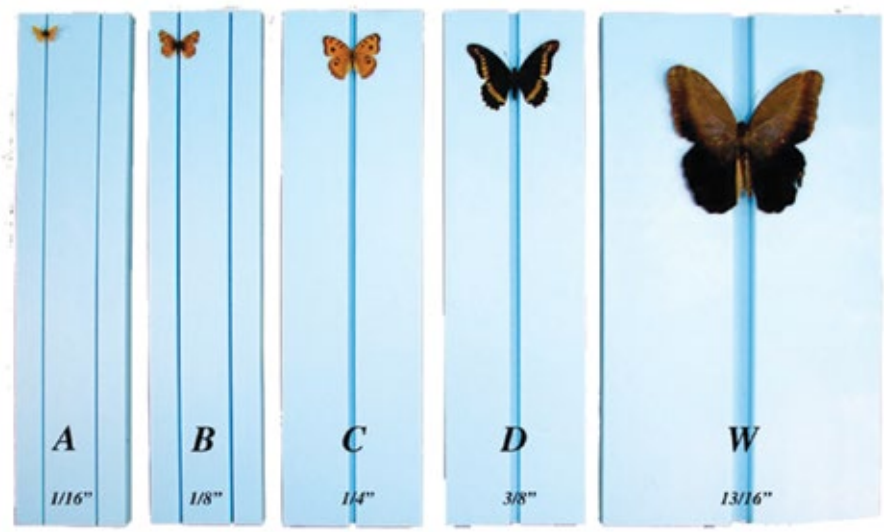

Figure 31: Polystyrene pining boards (Photo by: BioQuip Products, Inc).

2.2.12 Spreading blocks

An individual pinning block that holds only one insect can be handmade of any soft material like polystyrene.

2.2.13 Riker mounts

Some specimens like butterflies, moths, beetles can be placed in a ricker (Figure 32) after being dried without a pin. Such a method is used for teaching entomology or for display of specimens.

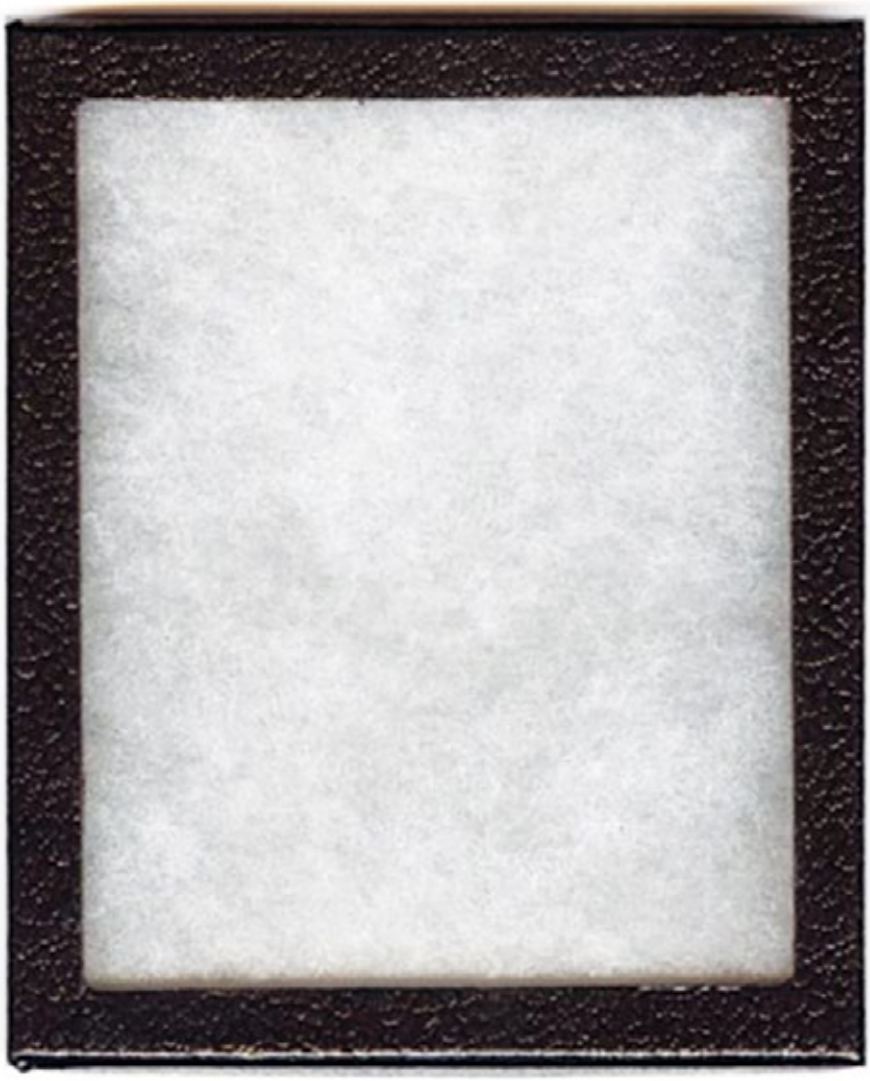

Figure 32: Insect ricker (Photo by: BioQuip Products, Inc).

2.2.14 Labeling

The most important information that should be written on a specimen label is the place, date and the collector's name. A temporary label should be placed with the specimen while in the field. Then, two permanent labels should be printed and placed under the insect.

The first should include the following data:

- Coordinates
- Country, governorate, or county
- City, site location
- Date: xx.yy.2022
- Collector, host, or method of collecting

The second label should include:

- Scientific name of the specimen
- Name of determiner and year of determination

A font size of 4 or 5 is suitable for these labels. A field notebook is highly recommended to document ecological notes, insect behavior, association with other species, population density or abundance. This will give the opportunity to record data that cannot otherwise be written on a small label.

To ensure that the specimen, and the two labels are placed in a correct position, a steppe pinning block may be used (Figure 33).

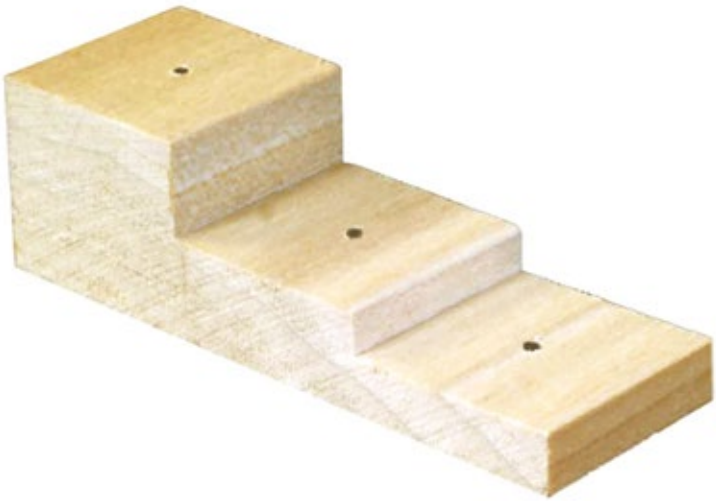

Figure 33: Stepped pinning block (Photo by: BioQuip Products, Inc).

A heavy type, acid-free paper should be used for labeling so that the label will not become loose on the pin and the colour of paper does not curl, become yellow, brittle, or disintegrate in liquid preservatives with time.

2.2.15 Curating and housing the collection

It is important to adopt standard equipment for housing a collection because uniformity of containers will allow easy additions and expansion of the collection.

2.2.15.1 Vials

Material preserved in liquid needs replacement of preservative and stoppers if evaporation is noticed. Frequent examination of vials should be done to prevent specimens from drying. Vials may be kept in unit trays placed in cabinet drawers (Figure 34) or acrylic vial rack (Figure 35).

Figure 34: Vial drawer with partitioned vial unit trays (Photo by: BioQuip Products, Inc).

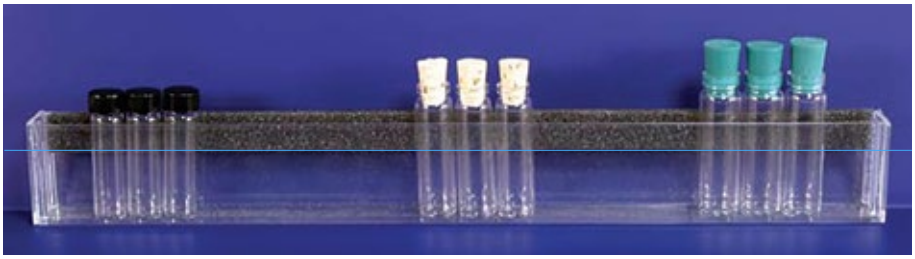

Figure 35: Acrylic vial rack (Photo by: BioQuip Products, Inc).

2.2.15.2 Microscope slides

Microscope slides should be kept in slide boxes Figure 29 preferably in horizontal position unless they are totally dry.

Figure 36: Polypropylene slide box (Photo by: BioQuip Products, Inc).

2.2.15.3 Pinned specimens

Pinned specimens may be kept in insect drawers such as at the U.S. National Museum, California Academy of Sciences, Cornell, or Schmitt insect boxes (Figure 37, 38, 39).

Unit trays (Figure 40) with polyethylene foam bottoms, which are made of various sizes, are placed in drawers in cabinets. This facilitates the organization and moving specimens.

Figure 37: Standard insect box (Photo by: BioQuip Products, Inc).

Figure 38: Cornell insect drawer (Photo by: BioQuip Products, Inc).

Figure 39: Cornell University system cabinets for 12 drawers (Photo by: BioQuip Products, Inc).

Figure 40: Unit trays (Photo by: BioQuip Products, Inc).

Insect boxes must be closed airtight to keep out museum pests such as dermestid beetles, booklice, ants, or other insects.

2.2.15.4 Protecting the collection from insect pests and molds

To kill insect pests that attack museum specimens, drawers containing dry specimens should be placed in airtight plastic bags and placed in the freezer for 2–5 days at -20°C to -25°C. Any recently received shipment of insect boxes or insect donations should be immediately frozen before being incorporated into the collection.

Fumigation with solid fumigants such as paradichlorobenzene (PDB) or naphthalene should be carried out periodically for the entire collection. However, these substances are banned in some countries due to their potential harmful effects on humans.

To control active infestations, liquid fumigants such as carbon disulfide, carbon tetrachloride, chloroform, ethyl acetate, and ethylene dichloride may be used since they act faster than solid fumigants. The use of a fumigation chamber or a large plastic bag is recommended. The fumigant is place on a cotton ball then placed in the infested box for one day.

The insect collections should be kept away from dust, and windows should be screened to keep out insect pests.

Insect collections should always be kept in a dry place to prevent mold. In humid climates, artificial dehumidification may be necessary.

(Photo by Aref Alawadhi)

3 Insects of Kuwait

3. Insects of Kuwait

Several publications on the insect fauna of Kuwait have been published over the past 80 years. (Uvarov, 1930; Abushama & Cloudsley-Thompson, 1978; Clayton & Pilcher, 1983; Al-Houty, 1989; 1997; 2011; Horváth & Zeil, 1996).

Al-Houty (2009) summarized the known species of insects in Kuwait until 2008. Later, Al-Houty (2011) updated the list of recorded insects in Kuwait reaching 684 species.

A total of 19 insect orders currently occur in Kuwait.

Table (1) shows the world insect orders with the number of described species in each and the orders that are not known to exist in Kuwait.

Table 1. Numbers of described species in the major taxa constituting the Arthropoda in the *Catalogue of Life* from Zhang (2011). Taxa in bold are not known to occur in Kuwait.

Taxon	World number of species
Subphylum Hexapoda	1,023,559
Class Collembola	8,130
Class Protura	804
Class Diplura	800
Class Insecta	1,013,825
Order Archaeognatha (Microcoryphia)	513
Order Zygentoma (Thysanura)	560
Order Ephemeroptera	3,240
Order Odonata	5,899
Order Orthoptera	23,855
Order Phasmida	3,014
Order Embioptera (Embiidina)	463
Order Grylloblattodea	34
Order Mantophasmatodea	15
Order Plecoptera	3,743
Order Dermaptera	1,978

Order Zoraptera	37
Order Mantodea	2,400
Order Blattodea	7,314
Order Psocoptera	5,720
Order Phthiraptera	5,102
Order Thysanoptera	5,864
Order Hemiptera	103,590
Order Hymenoptera	116,861
Order Strepsiptera	609
Order Coleoptera	386,500
Order Neuroptera	5,868
Order Megaloptera	354
Order Raphidioptera	254
Order Trichoptera	14,391
Order Lepidoptera	157,338
Order Diptera	155,477
Order Siphonaptera	2,075
Order Mecoptera	757

The following is a species account of the insect of Kuwait. If scientific names mentioned in earlier literature were changed, only the valid names were included in the lists. A brief morphological description, biological or ecological data about each insect order, and families in each order is given which was mainly adapted from Borror et al. (2005) and/or relevant literature. The families are listed alphbatically in each order. If less than five species occur in a certain family thay are mentioned in the text, otherwise thay are listed in a table.

3.1 Order Zygentoma (Thysanura) (Silverfish and firebrats)

Thysanura are flattened wingless insects. They have two long cerci and a median filament, the compound eyes are small and separated or absent, the body is covered with scales, mouthpart are of the chewing type, with two points of articulation, styli on 2–9, 7–9, or 8–9 abdominal segments. They are found under bark, in litter on soil surface, in caves, in ant nests, and deserts. They are omnivorous feeding on starchy materials. Some species are pests in libraries because they eat book bindings. They also feed on labels, curtains, linens, silks, and starch paste in wallpaper. Two common species from Lepis-

matidae were previously recorded from Kuwait: *Lepisma saccharina* Linnaeus, 1758 (Figure 41) and *Thermobia domestica* Packard, 1873.

Figure 41: *Lepisma saccharina* Linnaeus, 1758 (Photo by A. Katbeh-Bader).

3.2 Order Ephemeroptera

Ephemeroptera (Mayflies) are aquatic insects found in streams and ponds. They are elongate, with four membranous wings and two or three thread-like caudal filaments. Immatures with leaf-like or plumose gills on the sides of the abdomen and the three (rarely two) long tails. They feed on algae and detritus. Mayflies are unique in class Insecta because they are the only insects that molt again after the wings become functional. Duration of the nymphal stage is about 1–2 years. Adults have non-function mouthparts and live for 1–2 days. Mayflies mate during swarming. Eggs are attached to objects in the water or laid on the surface of the water. Adults and nymphs are consumed by fish, amphibians, birds, and spiders. Mayflies are important ecological indicators for water pollution. They are often studied with another two ecologically important aquatic insect orders, Plecoptera and Trichoptera.

Family Baetidae (Small minnow mayflies)

The family Baetidae includes about 1,000 described species. Adults are small (front wings 2–12 mm). Baetidae breed in a wide range of waters from lakes and streams to ditches and even water butts. They differ from other mayflies that have hind wings small or absent in having two caudal filaments. Male eyes are turbinate. The nymphs occur in a variety of aquatic habitats. They are strong swimmers and feed mainly on algae. *Cloeon dipterum* (Linnaeus, 1761) was recorded from Kuwait. The nymph and its mouth parts are shown in (Figure 42).

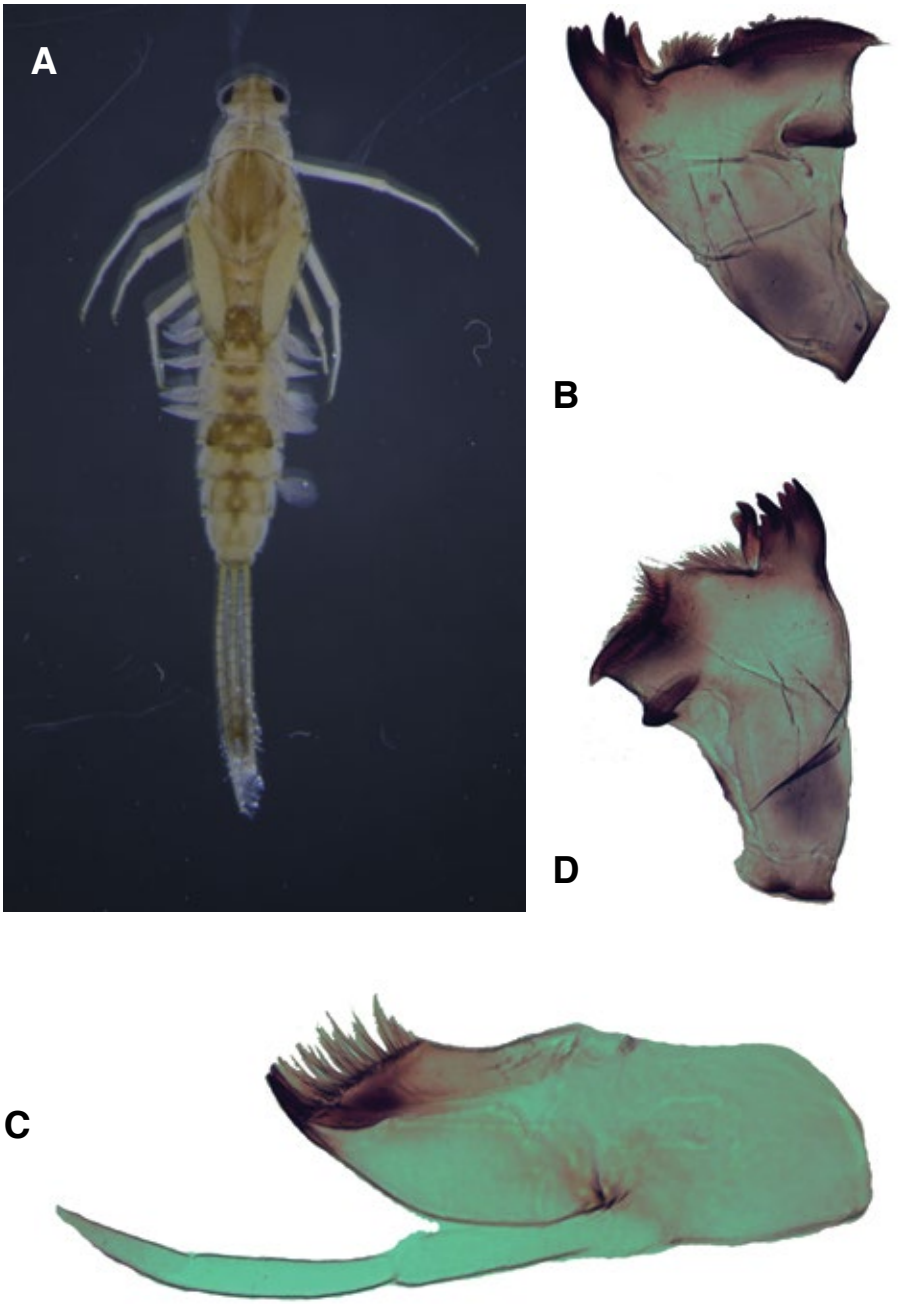

Figure 42: *Cloeon dipterum* (Linnaeus, 1761) A. Dorsal view B. Mandible dorsal view C. Maxilla. D. Mandible ventral view (Photos by A. Katbeh-Bader).

Family Polymitarcyidae (Pale burrower mayflies)

AdultPolymitarcyidae have the middle and hind legs of the male, and all legs of the female, greatly reduced or vestigial. Larvae have gills on abdominal segments, 2–7 are forked and elongate lanceolate with fringed margins. The mandibular tusks have spines on the top surface and are not curved upward. The ventral apex of the hind tibia is rounded. *Polymitarcys savignyi* Eaton, 1883 is the only species known from Kuwait.

3.3 Order Odonata (Dragonflies and damsel flies)

The name "Odonata" is taken from Ancient Greek, and which means 'tooth' referring to the teeth on the mandibles. Dragonflies (suborder Anisoptera) are usually larger, their eyes close together and wings are held up or at sides of the body while at rest. Damselflies (suborder Zygoptera) are usually smaller in size, their eyes are separated, and the wings are held along body while at rest. Odonata is an aquatic insect order. The immatures and adults are insectivorous. Adults spend most of their time flying. Their legs are adapted for catching their prey. Present-day Odonata range in length from 2 cm - 13.5 cm. Extinct dragonflies which lived about 250 million years ago, had a wingspan of about 71 cm. The gills of damselfly nymphs are three leaflike structures at the end of the abdomen which help in swimming. The gills of dragonfly nymphs are in the rectum. During breathing, a dragonfly nymph draws water into the rectum through the anus and then expels it resulting in "jet propulsion" locomotion.

Currently, 6,317 species are known worldwide Paulson and Schorr (2005–2021). The Odonata of Kuwait were studied by Al-Houty (1985). So far, a total of 12 species have been recorded in four families. More data on the distribution of the dragonflies of Kuwait are included in Waterston and Pittaway (1991).

Suborder Anisoptera (Dragonflies)

Family Aeshnidae (Darners)

The Aeshnidae are the largest and most powerful of the dragonflies. *Anax parthenope* (Selys, 1839) and *Anax ephippiger* (Burmeister, 1839) occur in Kuwait.

Family Gomphidae (Clubtails)

Gomphidae or called clubtails are represented in one species that may be found along streams. They can be easily distinguished by swollen terminal abdominal segments, hence the common name for the group. *Lindenia tetraphylla* (Vander Linden, 1825) is found in Kuwait.

Family Libellulidae (Skimmers)

The Libellulidae is the most widespread family with eight species recorded in Kuwait so far (Table 2). Most of them are commonly found near ponds and swamps. *Crocothemis erythraea* (Brulle, 1832) is shown in in Figure 43.

Figure 43: *Crocothemis erythraea* (Brulle, 1832) (Photos by A. Katbeh-Bader)

Table 2: Libellulidae of Kuwait.

Crocothemis chaldaeorum Morton, 1920
Crocothemis erythraea (Brulle, 1832)
Crocothemis servilia (Drury, 1770)
Orthetrum sabina (Drury, 1773)
Orthetrum taeniolatum (Schneider, 1845)
Selysiothemis nigra (Vander Linden, 1825)
Trithemis annulata (Beauvais, 1807)
Trithemis arteriosa (Burmeister, 1839)

Suborder Zygoptera (Damselflies)

Family Coenagrionidae (Pond damsels)

The Coenagrionidae live along streams and around ponds or swamps. They are weak fliers. At rest, the body is held horizontal and wings together over the body. *Ischnura evansi* Morton, 1919 is known to occur in Kuwait.

3.4 Order Orthoptera

Order Orthoptera is a diverse insect order containing many common and well-known species. The mouthparts are mandibulate (chewing type). The metamorphosis is simple. Most Orthoptera are phytophagous, and some may become serious pest like locusts. Some species are predaceous on other insects, while others may be omnivorous or scavengers.

Both winged and wingless species occur in this order. Winged species have four wings. The front wings are elongate, leathery, with many veins and the many-veined hind wings are broad, membranous, and are folded fanwise beneath the front wings when the insect is at rest.

The forewings or hindwings or both may be reduced or even absent in some species. The antennae are many segments and long, sometimes longer than the body. The body is elongate, with well-developed cerci. The female ovipositor in some species may be as long as the body, while in others may be short and inconspicuous. The grasshopper of Kuwait consists of 31 species in five families. Our data were based on records of Uvarov (1930), Al-Houty (1997; 2009; 2011) and Gorochov (1993).

Family Acrididae (Grasshoppers and locusts)

In this family, a grasshopper's antennae are shorter than its body. The tympana (auditory organs) are present laterally on the first abdominal segment.

The ovipositor is short. Grasshoppers and locusts are plant feeders and thus may be seriuos plant pests. Table (3) includes 24 species recorded from Kuwait. *Anacridium aegypticum* (Linnaeus, 1764) is shown in Figure 44, *Locusta migratoria* (Linnaeus, 1758) in Figure 45A, *Aiolopus thalassinus* (Fabricius, 1781) in Figure 45B and *Schistocerca gregaria* (Forskol, 1775) in Figure 46.

Table 3: Acrididae (Grasshoppers and locusts) of Kuwait.

Acrotylus insubricus inficifus Walker, 1870
Aiolopus simulatrix (Walker, 1870)
Aiolopus thalassinus (Fabricius, 1781)
Anacridium aegypticum (Linnaeus, 1764)
Anacridium melanorhodon Dirsh, 1953
Cyclopternacris (Heteracris) muscatensis Popov, 1981
Duroniella lucasii (Bolívar, 1881)
Heteracris annulosus (Walker, 1870)
Hedotettix alienus Uvarov, 1936
Locusta migratoria (Linnaeus, 1758)
Mioscirtus wagneri (Kittary 1849)
Morphacris fasciata (Thunberg, 1815)
Ochrilidia geniculata (I. Bouvar, 1913)
Pseudosphingonotus paradoxus (Bey-Bienko, 1948)
Pseudosphingonotus savignyi (Saussure, 1884)
Pyrgmorpha cognata (Uvarov, 1943)
Pyrgmorpha conica-bispinosa Hsiung-Kevan, 1975
Schistocerca gregaria (Forskol, 1775)
Sphingonotus octofaciatus (Serville, 1838)
Sphingonotus rubescens (Walker, 1870)
Truxalis grandis Klug, 1830
Truxalis mesopotamic (Dirsh, 1956)
Truxalis procera (Klug, 1830)
Truxalis sp.
Utubius syriacus (Bolívar, 1893)

Figure 44: *Anacridium aegypticum* (Linnaeus, 1764) (Photos by A. Katbeh-Bader).

Figure 45: A. *Locusta migratoria* (Linnaeus, 1758) B. *Aiolopus thalassinus* (Fabricius, 1781) (Photos by A. Katbeh-Bader).

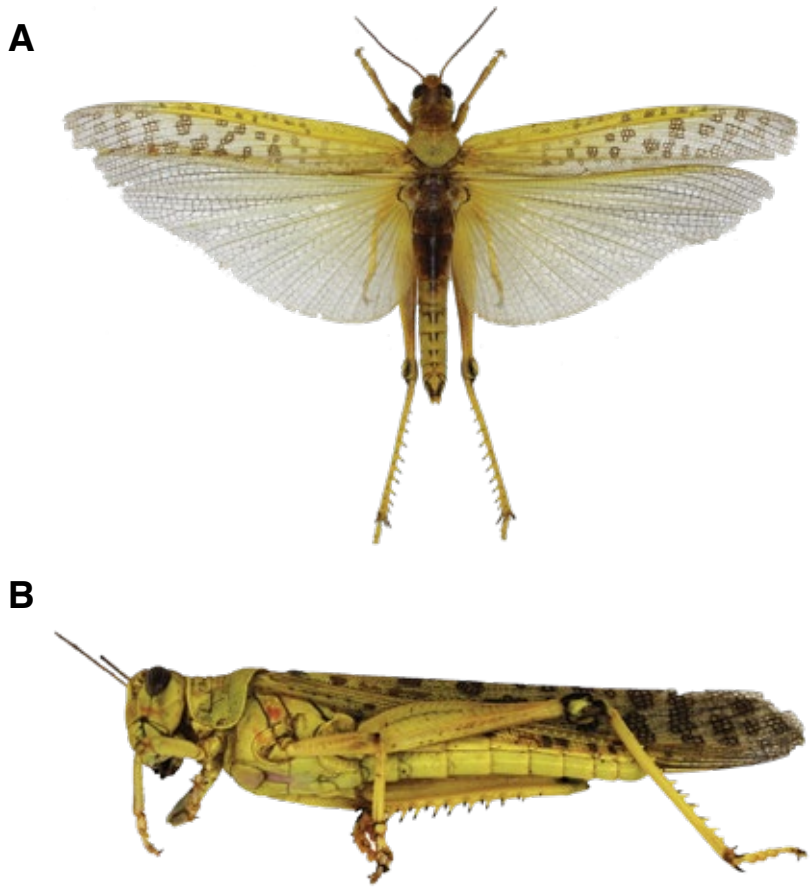

Figure 46: *Schistocerca gregaria* (Forskol, 1775) A. Dorsal B Ventral view (Photos by A. Katbeh-Bader).

Family Tettigoniidae (Katydids)

Katydids can be distinguished by their long, thin antennae, the four-segmented tarsi, the tympana (if present) are at the base of the front tibiae, and the sword-shaped ovipositor. Most species produce sounds by stridulation. They are mainly phytophagous, and some species are predators on other insects. *Euconocephalus incertus* (Walker, 1869) is known to occur in Kuwait.

Family Pamphagidae (Toad grasshoppers)

The **Pamphagidae** are a family of grasshoppers that are found in Africa, Europe, and Asia (Cigliano et al., Orthoptera Species File). *Eremotmethis carinatus* (Fabricius, 1775) and *Thrincus campanulatus* Fischer von Waldheim, 1833 are found in Kuwait.

Family Gryllidae (Crickets)

Gryllidae have long, setaceous antennae. Stridulating organs are located on the front wings of the male, while the tympana are on the front tibiae. The ovipositor is needle-like or cylindrical. Crickets are well-known singers, and each species has a characteristic song which can be heard from a great distance. They are found in the wild as well as in or around houses and gardens.

Four species of Gryllidae occur in Kuwait: *Acheta domestica* Linnaeus, 1758, *Gryllodinus kerkennensis* (Finot, 1893), *Gryllus bimaculatus* De Geer, 1773; and *Gryllodes sigillatus* (Walker, F., 1869).

Gryllidae Gryllotalpidae (Mole crickets)

Mole crickets are cylindrical-bodied insects, with small eyes and shovel-like forelegs adapted for digging. Sometimes they may become agricultural pests, especially in nurseries. One species of this family occurs in Kuwait, *Gryllotalpa gryllotalpa* (Linnaeus, 1758).

3.5 Order Embiidina (Webspinners or footspinners)

Embiidina (webspinners) are small slender insects chiefly tropical in distribution. The hind femora are thickened, the basal segment of the front tarsi is enlarged and contains silk glands and hollow spinning hairs. Females are always wingless, males with or without wings. Members of this order live in silken galleries spun in debris, in cracks in the soil, under stones, on or under bark, among mosses or lichens. All stages can spin silk, even the first instar. Most species live in colonies. They feign death when disturbed, usually running back ward. Eggs are laid in galleries and often covered with chewed food particles. Eggs are attended by females. They feed on dead grass and leaves, moss, lichens and bark. *Embia major* Imms, 1913 of the Embiidae occurs in Kuwait.

Family Embiidae (Webspinners)

The Embiidae includes 20 genera and 80 described worldwide. Only one species is known from Kuwait, *Embia major* Imms, 1913 (Figure 47).

Figure 47: *Embia major* Imms, 1913 (Photo by A. Katbeh-Bader).

3.6 Order Dermaptera (Earwigs)

Dermaptera are elongate flattened, slender wingless insects or winged with one or two pairs of wings. They are active at night, whereas during the day, they hide in debris, cervices, cracks, and under bark. Earwigs feed on dead and decaying vegetable matter, but some feed on living plants. Few are predaceous. Eggs are laid in burrows in the ground and protected by the mother until they hatch. Earwigs over winter in the adult stage. They do not bite, but if handled may pinch.

Family Labiduridae (Striped earwigs)

Striped earwigs have antennae with 25-30 segments; pronotum light brown with two dark longitudinal stripes, 20-30 mm long. Thay are attracted to light traps. *Labidura riparia* (Pallas, 1773) occurs in Kuwait (Figure 48).

Figure 48: *Labidura riparia* (Pallas, 1773) Male (L), Female (R) (Photos by A. Katbeh-Bader).

Family Labiidae (Little earwigs)

The Little earwigs have their antennae with 10-16 segments, less than 20 mm long, tegmina normally developed and meeting along entire midline, male forceps symmetrical. Its flight activity is during early evening, and it is also attracted to light at night. *Labia minor* (Linnaeus, 1758) is known to occur in Kuwait.

3.7 Order Mantodea (Praying mantids)

The order Mantodea includes approximately 2,300 described species in about 430 genera (Tree of Life Web Project, 2003), most of them are tropical. Members of this order have an elongated body, triangular head, mobile, with large compound eyes, predatory front legs armed with spines, two pairs of wings, the front leathy and the hind membranous. Some species have reduced wings and others are wingless. The males of most species have well-developed wings, while females have reduced or no wings.

Mantids prey upon insects including other mantids. They wait for their prey with the front legs in an upraised position which gave them the common name “praying mantis”. Eggs are laid in a foamy egg case, called an “ootheca”, which hardens onto twigs or grass stems. The nymphs look like adults but smaller in size, without wings or may have developing wing buds. Many species of praying mantids mimic leaves, sticks, bark, blades of grass, ants, or wasps.

Eight families are usually recognized worldwide. Five species in three families of praying mantises have been recorded from Kuwait (Al-Houty, 1997; 2011).

Family Mantidae (Praying mantids)

The Mantidae is the largest family in this order containing about half of the known species worldwide. Two species were recorded previously from Kuwait. *Ameles spallanzania* (Rossi, 1792) *Mantis religiosa* Linnaeus, 1758

Family Empusidae (Cone-headed mantis)

The Empusidae have anteriorly projecting conical process on the head (vertex) with which is divided at the apex. They frequently mimic the plant on which they seek the prey. Two species were recorded previously from Kuwait: *Blepharopsis mendica* Giglio-Tos, 1917 (Figure 49) and *Hypsicorypha gracilis* (Bur-meister, 1838).

Figure 49: *Blepharopsis mendica* Giglio-Tos, 1917 (Photo by A. Katbeh-Bader).

Family Eremiaphilidae (Desert mantis)

The Eremiaphilidae are short, stout insects with square pronotum, approximately as long as wide. They are ground dwelling, fast runners and do not fly because of their very reduced wings. Only one species was recorded previously from Kuwait. *Eremiaphila braueri* Krauss, 1902.

3.8 Order Blattodea (Cockroaches)

Blattodea (Cockroaches) have running (cursorial) legs without modification for digging or grasping. The are very fast runners. The body is oval, flattened, the head is concealed under the pronotum. Hearing organ (tympana) and sound producing organs (stridulatory organs) are usually absent. The are omnivorous. Eggs are laid in ootheca which may be deposited immediately after they are formed or carried on the abdomen of the female until they hatch, or they are carried internally in a uterus or brood pouch for the full gestation period. Cockroaches are not biological vector of diseases, but they mechanically contaminate food with microorganisms. They are annoying by their presence and high infestation give unpleasant odor in houses. Seven species in four families were recorded from Kuwait.

Family Hodotermitidae (The harvester termites)

The harvester termites have serrated mandibles and all castes have func-

tional compound eyes. They feed on and collect grass during the day and night. *Anacanthotermes vagans* (Hagen, 1858) was recorded from Kuwait.

Family Rhinotermitidae (Subterranean termites)

Rhinotermitidae are worldwide in distribution. They feed on wood and some species are considered serious pests in building or any other other wooden materials or structures. *Psammotermes hybostoma* Desneux, 1902 was recorded from Kuwait.

Family Blattidae (Oriental, American, and other cockroaches)

Blattidae includes several household pests. Most species are 25 mm long or longer. The American cockroach, *P. americana* (L.). is a large (29-53 mm long) common cosmopolitan species. It is reddish brown, with well-developed wings. *Blatta lateralis* Walker, 1868, *Blatta mellea* Krauss, 1902, and *Periplaneta americana* (Linnaeus, 1758) (Figure 50) are the species found in Kuwait.

Figure 50: *Periplaneta americana* (Linnaeus, 1758). A. Female, dorsal B. Male, dorsal C. Female, ventral D. Male, ventral (Photos by A. Katbeh-Bader).

Family Ectobiidae (Wood cockroaches)

Ectobiidae were formerly known as Blattellidae. These cockroaches are smaller than Blattidae. Some species are common household pests. The German cockroach, *Blatella germanica* (Linnaeus, 1767) (Figure 51) is a very common pest which was recorded in Kuwait in addition to *Blattella biligata* (Walker, 1868).

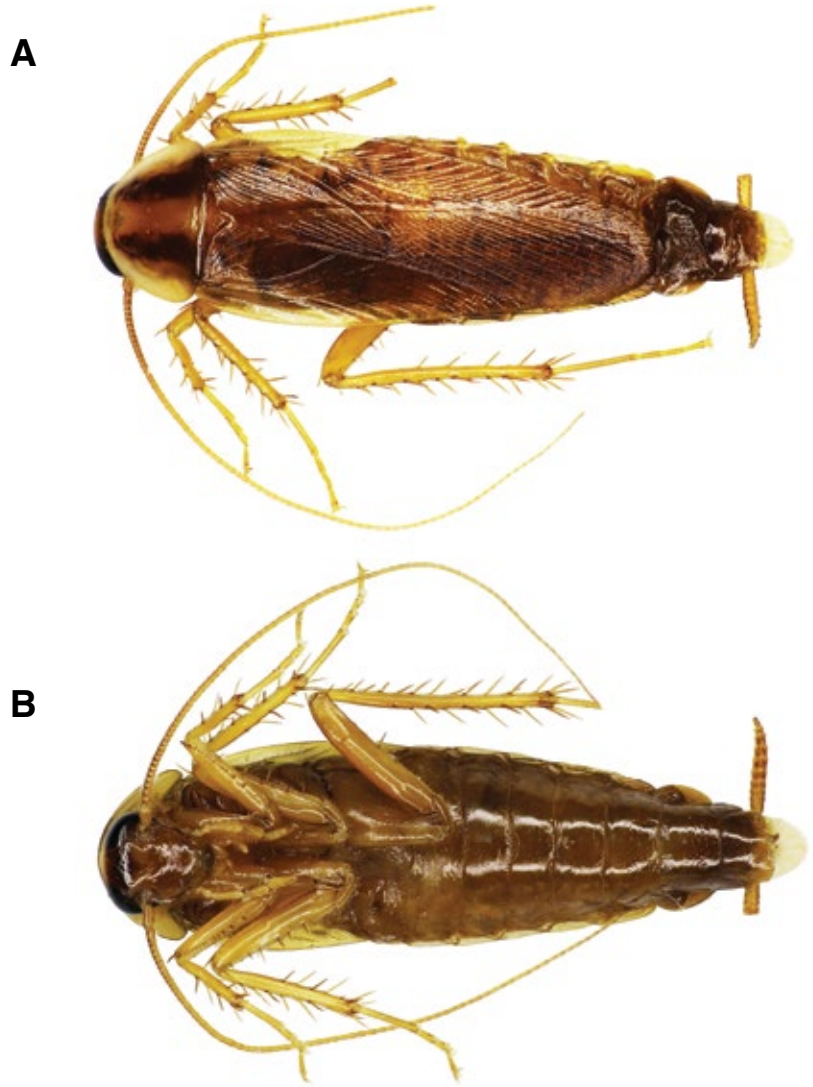

Figure 51: *Blatella germanica* (Linnaeus, 1767) A. Dorsal B. Ventral (Photos by A. Katbeh-Bader).

3.9 Order Phthiraptera

Lice are wingless ectoparasites of birds and mammals. They were previously divided into two orders, the Mallophaga (chewing lice) and Anoplura (sucking lice). Currently, they are considered one order Phthiraptera which is divided into suborders: Anoplura, Amblycera, and Ischnocera, and Rhynchophthirina. Anoplura includes parasites of domestic animals and two species that feed on blood of humans causing irritation and transmission of diseases.

Suborders Amblycera and Ischnocera are mainly pests of poultry. They cause irritation, and heavy infestation may lead to the death of the animal. Rhynchophthirina, contains three species that attack elephants and some African pigs.

Suborder Anoplura

Three species of sucking lice were reported by Al-Houty (1983): *Polyplax spinulosa* (Bur-meister, 1839) from the family Polyplacidae and *Pediculus humanus humanus* Linnaeus, 1758 and *Pediculus humanus capitis* De-Geer,1778 from the family Pediculidae.

Suborder Mallophaga

Four species of chewing lice were reported by Al-Houty (1983): *Menacanthus stramineus* (Nitzsch, 1818) (Menoponidae); *Columbicola columbae* (Linnaeus, 1758) and *Goniodes numidae* Mjoberg, 1910 (Philopteridae); and *Damalina ovis* (Schrank, 1781) (Trichodectidae).

3.10 Order Thysanoptera (Thrips)

Thysanoptera (Thrips) are small insects most of which measure 1 mm. However, some predatory thrips may reach 14 mm in length. They have two, fringed, similar pairs of wings. Adults and immatures have “punch and suck” mouthparts. Thrips are mycophagous, phytophagous, carnivorous, and pollen feeding. They eat other thrips, aphids, mites, and whiteflies. There are two active feeding instars, larvae I, and larvae II and two or three quiescent, non-feeding instars (the pre-pupa or pro-pupa and pupa) which lack functional mouthparts.

Family Thripidae (Thrips)

Many species of the Thripidae feed in flowers and on leaves. The onion thrips, *Thrips tabaci* Lindman, from the family Thripidae was recorded from Kuwait. It is a pest on onion, tobacco, beans and other plants. However, it may be considered as a beneficial natural enemy against the leaf-feeding spider mites.

3.11 Order Hemiptera

Suborder Sternorrhyncha

This suborder includes aphids, whiteflies, and scale insects. They were previously included in order Homoptera. This suborder is represented by three families: Aleyrodidae, Aphididae and Diaspididae, with a total of eight species. All records were extracted from Al-Houty (1997).

Family Aleyrodidae (Whiteflies)

Whiteflies usually have whitish opaque wings, covered with whitish powder; hind wings nearly as large as front wings; with no cornicles. The whiteflies are minute insects, that resemble tiny moths, and are rarely more than 2 or 3 mm long. The adults of both sexes are winged, and the wings are covered with a white dust or waxy powder. *Bemisia tabaci* (Gennadius, 1889) is the only recorded species in Kuwait so far.

Family Aphididae (Aphids)

The Aphididae have the front wings usually with four or five (rarely six) veins behind stigma extending to wing margin); cornicles usually present; antennae usually 6-segmented. Some species have many different morphs. Some species require a woody and an herbaceous host to complete their life cycle. In bisexual species, females lay eggs (oviparous), while in parthenogenetic species, females deliver nymphs (viviparous). Many species are common plant pests. Five species were recorded from Kuwait to date (Table 4).

Table 4: Aphids of Kuwait.

Aphis fabae Scopoli, 1763
Aphis nerii Fonscolombe, 1841
Brevicoryne brassicae (Linnaeus, 1758)
Myzus persicae (Sulzer, 1776)
Rhopalosiphum maidis (Fitch, 1856)

Family Diaspididae (Armored seales)

Family Diaspididae are small insects, the females are soft-bodied, covered with a scale covering which is formed of wax secreted by the insect and with the excretions and cast skins of the early instars. The scales vary in shape and colour. They may be circular or elongate, smooth, or rough, and variously coloured. The male scale covers are usually smaller and more elongate than those of the female. Females are eyeless and legless. The males have two wings, with well-developed legs and antennae. Only three species were recorded from Kuwait so far: *Aonidiella orientalis* (Newstead, 1894), *Parlatoria*

blanchardii (Targioni-Tozzetti, 1892) and *Phoenicococcus marlatti* Cockerell, 1899. More spcies are expected to occur in Kuwait when such a group is targeted further in collecting.

Suborder Auchenorrhyncha

This suborder includes three families with nine species known from Kuwait. The leafhoppers (Cicadellidae), plant hoppers (Delphacidae) and Tropiduchid Planthoppers (Tropiduchidae). All records were extracted from Al-Houty (1997).

Family Cicadellidae (Sharpshooters and doggers)

The Cicadellidae is recognized by one or more rows of small spines on the hind tibiae. It is a large family with more than 20,000 species in the world. Many are pests that suck plant juices and produce whitish or yellowish leaf spots, puncture plant tissue while laying eggs, plug conductive tissue of stalks, excrete honeydew, on which a sooty mold develops reducing photosynthesis. Some species are vectors of plant diseases. Eight species are known to occur in Kuwait (Table 5). *Hecalus glaucescens* (Fieber, 1866) in shown in Figure (52A) and *Neoalimus aegyptiacus* (Matsumura, 1908) in Figure 52 B.

Table 5: Cicadellidae of Kuwait.

Cicadella viridis (Linnaeus, 1758)
Cicadetta musiva (Germar, 1830)
Empoasca fabae (Harris, 1841)
Hecalus glaucescens (Fieber, 1866)
Neoalimus aegyptiacus (Matsumura, 1908)
Neoaliturus tenellus (Baker, 1896)
Paralimnus inexpectatus Dlabola, 1961
Platypleura arabica Myers, 1928

Family Delphacidae (Planthoppers)

Delphacidae (planthoppers) can be recognized by the large, flattened spur at the apex of the hind tibiae. Most species are small, and many have reduced wings. They feed on grasses in wet areas, sedges, rushes, and broad-leaved plants, mainly members of the aster family. *Toya propinqua* (Fieber, 1866) was recorded from Kuwait, however further species may be discovered.

Figure 52: A. *Hecalus glaucescens* (Fieber, 1866) B. *Neoalimus aegyptiacus* (Matsumura, 1908) (Photos by A. Katbeh-Bader).

Family Tropiduchidae (Tropiduchid planthoppers)

These plant hoppers are distributed in the Old and New World tropics and subtropics. Front wings longer than abdomen, with a series of crossveins between costal margin and apex of clavus separating off the apical, more dense-

ly veined portion of the wing; slender, greenish, or yellowish brownish, some species has three longitudinal keels on the vertex, pronotum, and scutellum. A serious pest on date palms, the Dubas bug, or date bug as called in the old world, *Ommatissus binotatus* Fieber, 1875 was recorded from Kuwait (Figure 53).

Figure 53: *Ommatissus binotatus* Fieber, 1875 (Photo by A. Katbeh-Bader).

Suborder Heteroptera

This suborder includes a wide range of bugs: minute pirate bugs, bed bugs, milkweed bugs, damsel bugs, red bugs stink bugs and scentless plant bugs. It includes 19 families and 82 species. Two species (*Xylocoris etawahii* and *Xylocoris wasmiai*) of the family Anthocoridae were described from Kuwait (Ghauri, 1985). All other records are based on Al-Houty & Dolling (1999) and Al-Houty (1997 & 2011). In 1988, an outbreak of bites by *Leptodemus minutus* was reported (Selim et al., 1990) among humans. Al-Houty (1990) reported cases of *Nysius* feeding on human blood in Kuwait. Also, an outbreak of bed bugs infesations was reported in Kuwait (El-Azazy et al., 2013). A specimen of *Bemisia tabaci* (Gennadius, 1889) was found in the British museum specimen (NHMUK010134838), collected by W. Al-Houty in 1976 from Kuwait.

Family Alydidae (Broad headed bugs)

The Alydidae have long and usually narrow bodies, the head is as wide as pronotum, membrane of forewing with many veins. They are found on weeds and shrubs along roadsides and in woodland areas. Most species are yellowish brown or black. Two species are known from Kuwait up to the present time, *Alydus calcaratus* (Linnaeus, 1758) and *Hypselopus gigas* Burmeister, 1835.

Family Anthocoridae (Minute pirate bugs)

Anthocoridae are small, flattened bugs 2-5 mm long, elongate, with the asymmetrical male genitalia, the hemielytra with cuneus, few or no veins on the membrane of the forewing. Many species are black with whitish markings. Some species are found on the ground or under bark while many species occur on flowers and fruits. Most species are predators on small insects or insect eggs. Three species were recorded from Kuwait, *Xylocoris confusus* Carayon 1972, *X. etawahii* Ghauri 1985 and X. *wasmiai* Ghauri 1985.

Family Belostomatidae (Giant water bugs)

Belostomatidae are the largest bugs in the order (up to 10 cm in some South American species). They are elongate, oval, flattened, with raptorial front legs. They are found in ponds and lakes. Giant water bugs prey on aquatic insects, snails, tadpoles, and even small fish. They can leave water and fly away attracted to lights, thus they are also called 'electric light bugs'. Two species are known to occur in Kuwait. *Lethocerus fakir* (=*Lethocerus cordofanus* (Mayr, 1852) and *L. patruelis* (Stål, 1854).

Family Cimicidae (Bed bugs)

Cimicidae (bed bugs) are flat, broadly oval, wingless bugs about 6 mm long. They feed by sucking blood from birds and mammals. Some species of Cimicidae attack bats and birds. *Cimex lectularius* was recorded in Kuwait. It is a common bed bug that attacks people in houses and hotels during the night. It also attacks animals.

Family Coreidae (Squash bugs or Leaf-footed bugs)

Coreidae's head is much narrower than its thorax, with ocelli, many parallel veins in membranes of front wings, conspicuous scent glands on sides of thorax between middle and hind coxae. In leaf-footed bugs, the hind tibiae are expanded into thin, leaf-like plates. Four species were recorded from Kuwait, *Arenocoris intermedius* (Jakovlev, 1883), *Anasa tristis* (De Geer, 1773), *Centrocoris volxemi* (Puton, 1878) and *Coriomeris pallidus* Reuter, 1900.

Family Corixidae (Water boatman)

Corixidae (water boatman) are elongate and oval, dorsal surface flattened, with narrow dark crosslines. Front legs short, tarsi 1-segmented and scoop-shaped. Hind legs elongate, oar-like, with fine hairs. Two species were recorded from Kuwait, *Sigara lateralis* (Leach, 1817) and *Heliocorisa vermiculata* (Puton, 1874).

Family Cydnidae (Burrower bugs)

Cydnidae have the body usually ovoid, heavily sclerotized, dark. Legs often spiny. They are found under stones, in sand, or around the roots of grass tufts on which they feed. They are attracted to light. One species was recorded from Kuwait, *Macroscytus brunneus* (Fabricius, 1803).

Family Lygaeidae (Seed bugs)

Lygaeidae are common bugs which have the membrane of hemelytra with 4-5 usually simple veins arising from its base, all the abdominal spiracles are dorsal. Many species are brightly coloured orange and black or red and black. Species feed mainly on seeds, and some species feed on milkweeds and other plants, distasteful or toxic to animals. Some are plant pests. A total of 19 species were recorded from Kuwait to date (Table 6). *Nysius cymoides* (Spinola, 1837) is shown in Figure (54).

Table 6: Lygaeidae of Kuwait.

Camptocoris longicornis (Puton, 1874)
Camptocera glaberrima (Walker, 1872)
Cymophyes essabchana Seidenstucker, 1953
Dieuches armipes (Fabricius, 1794)
Emblethis gracilicornis Puton, 1883
Engistus exsanguis (Stål, 1872)
Geocoris acuticeps Signoret, 1881
Geocoris nigriceps (=*Geocoris chloroticus* Puton, 1888)
Geocoris phaeopterus (=*Geocoris megacephalus* (Rossi, 1790))
Ischnodemus caspius (Jakovlev, 1871)
Lachnesthus singalensis (=*Lanchnophorus singalensis* (Dohrn, 1860)
Lethaeus fulvovarius Puton, 1884
*Nysius cymoide*s (Spinola, 1837)
Nysius senecionis (Schilling, 1829)
Macropternella inermis (Fieber, 1852)
Remaudiereana annulipes (Baerensprung, 1859)
Spilostethus pandurus (Scopoli, 1763)
Spilostethus longulus (Dallas & W.S., 1852)

Figure 54: *Nysius cymoides* (Spinola, 1837) (Photo by A. Katbeh-Bader).

Family Nabidae (Damsel bugs)

Nabidae are slender bugs with the front femora slightly enlarged, and the membrane of the hemelytra has a number of small cells around the margin. They are predators on aphids, caterpillars, and other insects. Some species may have long-winged and short-winged forms, the latter form being more common. *Nobis capsiformis* (Germar, 1837) and *Nabis viridulus* Spinola, 1837 occur in Kuwait.

Family Nepidae (Waterscorpions)

Nepidae (waterscorpions) have raptorial front legs, and a long caudal breathing tube that enables the insect to take in oxygen. Waterscorpions are predaceous bugs that move slowly and prey on small aquatic animals which they capture with their front legs. Even though they have wings, they rarely fly. Their eggs are laid on or in tissues of aquatic plants. One species of Nepidae is known from Kuwait, *Ranatra parvipes* (Signoret, 1861).

Family Notonectidae (Backswimmers)

Notonectidae are aquatic bugs that have hind legs which are covered in long haris, and are modified for swimming, front legs not scoop-like as in Corixidae, dorsum convex, V-shaped when viewed from tip of abdomen, wings clear, tips without veins, eyes relatively close together, typically separated by less than the width of one eye. Backswimmers are predaceous, feeding on other insects, tadpoles, or small fish. *Anisops sardeus* Herrich-Schaeffer, 1849 and *Notonecta marmorea* Fabricius, 1803 were recorded from Kuwait.

Family Miridae (Plant bugs)

Miridae have special setae ('trichobothria') on middle and hind femora, lack ocelli, have a cuneus on the forewing, two closed cells in the forewing membrane, antennae mostly long and thin, legs slender and delicate. Most species are phytophagous, and some species are plant pests. Many species are predaceous on other insects. Nine species were recorded from Kuwait (Table 7).

Table 7: Miridae of Kuwait.

Auchenocrepis alboscutellata Puton, 1874
Campylomma unicolor Poppius, 1914
Eurystylus bellevoyei (Reuter, 1879)
Reuterista desertorum (Reuter, 1900)
Reuterista demeter (Linnavuori, 1974)
Trigonotylus pallidicornis Reuter, 1899
Tuponia concinna (Reuter, 1875)
Tuponia ninlil Linnavuori, 1984

Family Oxycarenidae (Seed bugs)

Members of Oxycarenidae family lack the explanate margins of the pronotum found in the Artheneidae but share with them the dorsal position of the spiracles of abdominal segment two. In the OldWorld tropics, some species are pests of cotton and other crops. *Leptodemus minutus* (Jakovlev, 1876) was recorded from Kuwait. It is not known to attack man, but it was suspected as causing an outbreak of pruritic eruptions in 100 patients in Kuwait (Selim et al. 1990). This species is sometimes found in large numbers in desert areas feeding on a variety of plants.

Family Pentatomidae (Stink bugs)

Pentatomidae have five-segmented antennae, three-segmented tarsi, large triangular scutellum in centre of back, shield-shaped body. Stink bugs produce a bad odor when irritated. Many species are brightly coloured or conspicuously marked. Ten species were recorded from Kuwait (Table 8).

Table 8: Pentatomidae of Kuwait.

Acrosternum breviceps (Jakovlev, 1890)
Acrosternum millierei (Mulsant & Rey, 1866)
Carpocoris purpureipennis DeGeer, 1773
Chroantha ornatula (Herrich-Schaffer, 1842)

Eurydema ornata (Linnaeus, 1758)
Eysarcoris incospicuus (Herrich-Schaffer, 1844)
Mecidea pallidissma Jensen-Haarup, 1922
Nezara viridula (Linnaeus, 1758)
Tarisa subspinosa (Germar, 1839)
Ventocoris martini (Horvath, 1880)

Family Pyrrhocoridae (Red bugs)

Pyrrhocoridae (red bugs) resemble some members of Lygaeidae but lack simple eye (ocelli) and have more veins and cells in the forewing membrane. Most species of Pyrrhocoridae are coloured black and red, and feed on seeds or fruits. A few species feed on rotting debris or dead animal matter. Some are found aggregated in large numbers on plants. Three species were recorded in Kuwait, *Pyrrhocoris apterus* (Linnaeus, 1758) (Figure 55), *Scantius aegyptius* (Linnaeus, 1758) and *Scantius forsteri* (Fabricius, 1781).

Family Reduviidae (Assassin bugs, Ambush bugs, and Thread-legged bugs)

Reduviidae have an elongate head, narrowing behind eyes, a prosternal groove between front legs, the lateral margins of abdomen extend beyond wings, and three-segmented proboscis. Most species are predaceous on other insects, but some species bite people and are blood feeders. Nine species were recorded in Kuwait (Table 9).

Table 9: Reduviidae of Kuwait.

Coranus aegyptius (Fabricius, 1775)
Coranus arenaceus Walker, 1870
Oncocephalus asiranus Miller, 1954
Lestomerus bicolor Villiers, 1948
Ectomocoris chiragra (Fabricius, 1803)
Ectomocoris ululans (Rossi, 1790)
Reduvius annulipes (Reuter, 1881)
Reduvius pallipes Klug, 1830
Vachiria natolica Stål, 1859

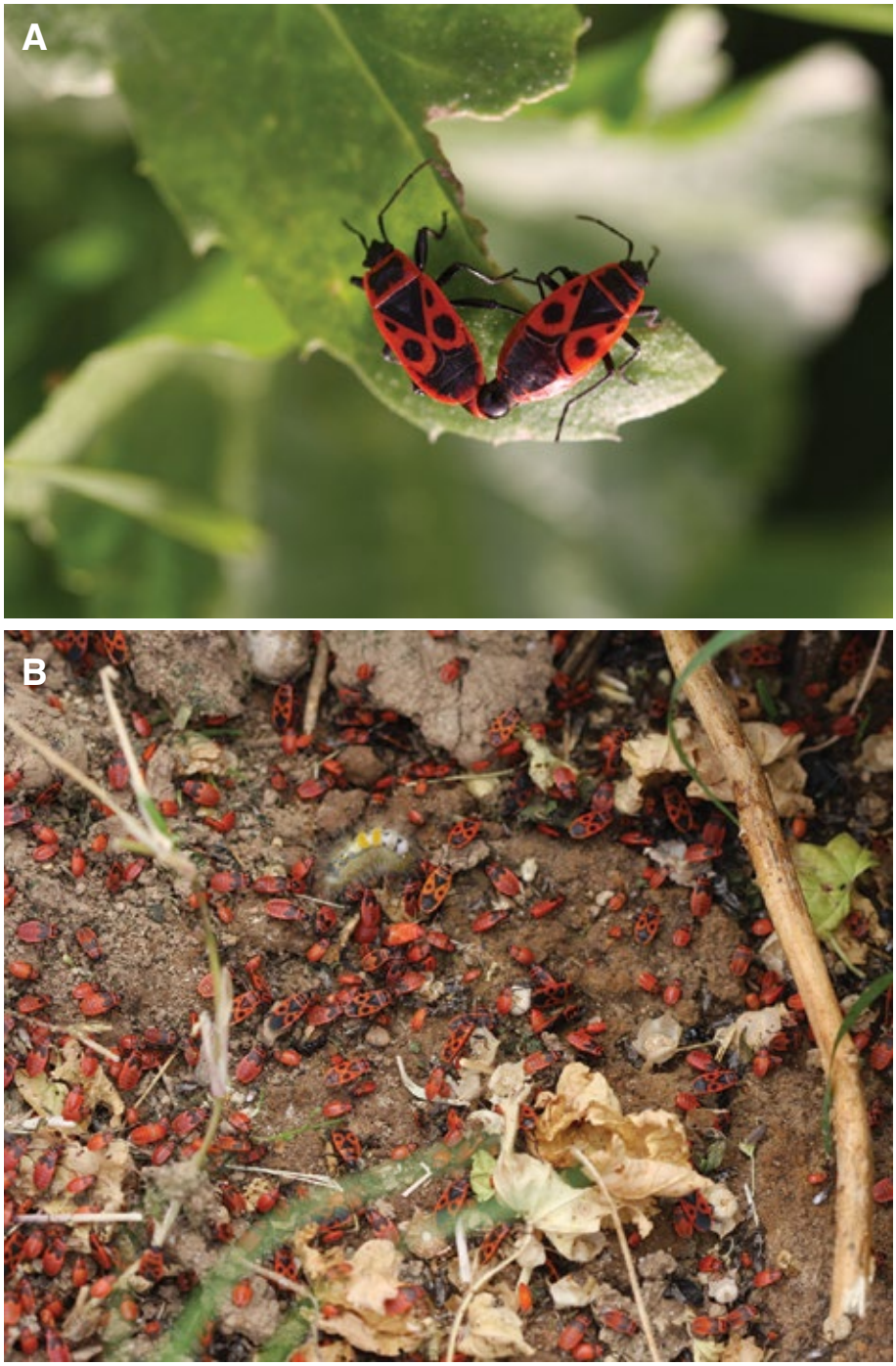

Figure 55: *Pyrrhocoris apterus* (Linnaeus, 1758) A. Mating male and female B. Large aggregation of adults and nymphs (Photos by A. Katbeh-Bader).

Family Rhopalidae (Centless plant bugs)

Rhopalidae differ from the coreids in lacking well-developed scent glands. They are usually light-coloured and smaller than the coreids. All are phytophagous feeding mainly on weeds, but a few are found on trees. Two species are known to occur in Kuwait, *Leptoceraea femoralis* (Horváth, 1897) and *Liorhyssus hyalinus* (Fabricius, 1794).

Family Stenocephalidae (Spurge bugs)

Stenocephalidae are characterized by the juga surpassing and usually being contiguous beyond the apex of the tylus, the membrane of forewing opaque with a large and a small basal cell from which radiate numerous anastamosing veins and the ventral abdominal spiracles. Two species are known to occur in Kuwait, *Dicranocephalus insularis* (Dallas, 1852) and *D. marginatus* (Ferrari, 1874).

Family Saldidae (Shore bugs)

Saldidae are oval, flattened, usually brown or black and white bugs. They have bulging eyes, membrane of forewings with four or five elongate closed cells. Shore bugs predaceous on other insects usually found along shores of streams, ponds, or the ocean. Some are burrowing in habit. Only *Saldula palustris* (Douglas, 1874) was recorded from Kuwait.

Family Tingidae (Lace bugs)

Family Tingidae are characterized by sculptured, lacelike pattern of the dorsum; ocelli absent, beak and antennae four-segmented, scutellum absent or much reduced, replaced by the angular hind portions of the pronotum, tarsi two-segmented. They are phytophagous mostly feeding on herbaceous plants but some feed on trees and may become important pests. Two species are known to occur in Kuwait, *Galeatus scrophicus* Saunders, 1876 and *Monosteira alticarinata* Ghauri, 1965.

3.12 Order Hymenoptera

The Hymenoptera of Kuwait includes 122 species in 17 families based on Al-Houty (1997 & 2011), Collingwood and Agosti (1996) and Luch (2008). A detailed study on the Sphecid wasps of Kuwait was published by Al-Houty (1978).

Three species of ants (Family Formicidae) were described from Kuwait: *Monomorium subcomae* (Lush, 2008), *Monomorium hemame* from Umm al-Hemam (Collingwood & Agosti, 1996), and *Monomorium buettikeri* from Anwha Island (Collingwood & Agosti, 1996).

Family Andrenidae (Mining bees)

Andrenidae can be identified by having two sulci below each antennal socket. They are small to medium-sized bees that nest in burrows in the ground similar to nests of Halictidae. Two species of Andrenidae were reported from Kuwait, *Andrena savignyi* Spinola, 1838 and *Panurgus dentatus* Friese, 1901.

Family Anthophoridae (Digger bees)

Anthophoridae are cosmopolitan family of solitary bees, but a few species have some degree of social behavior. Usually, they have elongate mouthparts. All females, and most males have a pygidial plate. Ten species were recorded from this family from Kuwait (Table 10).

Table 10: Anthophoridae of Kuwait.

Amegilla byssina (Illeger, 1806)
Anthophora angolensis (Dalla Torre, 1896)
Anthophora spinolana Priesner, 1957
Anthophora atriceps Pérez, 1879
Anthophora extricata Priesner, 1957
Eucera genovefae Vachal, 1907
Heliophila fayomensis (Priesner, 1957)
Icteranthidium ferrugineum (Fabricius, 1787)
Synhalonia pulmila (Klug, 1845)
Xylocopa aestuans (Linnaeus, 1758)

Family Apidae (Bumblebees and honeybees)

Apidae have numerous branched hairs that cover their bodies. The first segment of the hind tarsi is enlarged and bears a pollen basket. They are yellow, black, or honey brown in colour. The honeybee, *Apis millefera* (Linnaeus, 1758) was recorded from Kuwait (Figure 56).

Figure 56: *Apis millefera* (Linnaeus, 1758) (Photo by A. Katbeh-Bader).

Family Braconidae (Braconid wasps)

Braconidae are usually relatively small wasps resembling ichneumonids in lacking a costal cell but differ in that they have no more than one m-cu cross-vein, and the second and third metasomatic tergites are fused together. They are parasitoids on many insect pests, many of them are considered good bio-control agents and are used in integrated pest management programs. Three species were recorded from Kuwait: *Disophrys caesa* (Klug, 1835), *Microbracon brevicornis* (Wesmael, 1838) and *Aphidius picipes* (Nees, 1811).

Family Chrysididae (Cuckoo wasps)

Chrysididae have metallic, sculptured, blue, green, or coppery surface, abdomen with four of fewer segments, and teeth at the dorsal end. Larvae are parasites or inquilines in nests of other wasps or bees. Three species were recorded from Kuwait, *Stilbum cyanurum* (Forster, 1771), *Stilbum pici* Buysson, 1891 and *Stilbum splendidum* (Fabricius, 1775).

Family Halictidae (Sweat bees)

Halictidae are often metallic, small to moderate sized bees. They are distinguished by the strongly arched first free segment of the medial vein. Most nest in burrows in the ground making a vertical tunnel with lateral tunnels branching off from it and each terminating in a single cell. Three species were recorded from Kuwait: *Halictus variipes* Morowitz, 1876, *Nomioides variegata* (Olivier, 1789) and *Pseudapsis nilotica* (Smith, 1875).

Eumenidae (Mason and Potter wasps)

Eumenidae are usually black marked with yellow or white, or entirely black. Thy are solitary wasps nesting in twigs or logs, in the ground, or construct a nest of mud or clay. Most species provision their nests with caterpillars. Two species were recorded from Kuwait: *Delta campaniforme* (Saussure, 1852) *and D. dimidatipenne* (Saussure, 1852).

Family Evaniidae (Hatchet wasps)

Evaniidae are easily recognized by the base of abdomen high above hind coxa and the small flag abdomen. They are parasites of egg capsules of cockroaches. *Evania appendigaster* Linnaeus, 1758 was reported from Kuwait.

Family Formicidae (Ants)

Ants have elbowed antennae (geniculate) between the funiculus and the elongated scape, second abdominal segment forming a petiole, prognathous head. Wings of queens are shed after mating which occurs in mass nuptial flights. A total of 42 species of ants were recorded from Kuwait (Table 11).

Table 11: Formicidae of Kuwait.

Camponotus aegyptiacus Emery, 1915
*Camponotus fellah*Dalla Torre, 1893
Cataglyphis niger (Andre, 1882)
Camponotus xerxes Forel, 1904
Camponotus sericeus (Fabricius, 1798)
Camponotus thoracicus (Fabricius, 1804)
Cardiocondyla shuckardi Forel, 1891
Cataglyphis diehli (Forel, 1902)
Cataglyphis holgerseni Collingwood & Agosti, 1996
Cataglyphis lividus (Andre, 1881)
Cataglyphis niger (Andre, 1881)
Crematogaster antaris Forel, 1894
Lepisiota karawajewi (Agosti & Collingwood, 1987)
Messor aralocaspius (Ruzsky, 1902)
Messor arenarius (Fabricius, 1787)
Messor buettikeri Collingwood, 1985
Messor ebeninus Santschi, 1927
Messor medioruber Santschi, 1910
Messor meridionalis (Andre, 1883)
Messor minor (André, 1883)
Messor picturatus Santschi, 1927
Messor striaticeps (Andre, 1883)
Monomorium abeillei Andre, 1881
Monomorium areniphilum Santschi, 1911
Monomorium buettikeri Collingwood & Agosti, 1996
Monomorium buxtoni Crawley, 1920
Monomorium destructor (Jerdon, 1851)
Monomorium hemame Collingwood & Agosti, 1996
Monomorium venustum (Smith, 1858)
Monomorium nitidiventre Emery, 1893

Monomorium salomonis (Linnaeus, 1758)
Monomorium gracillimum (Smith, 1861)
Monomorium subdenticorne Collingwood & Agosti, 1996
Monomorium pharaonsis (Linnaeus, 1758)
Monomorium subcomae Lush, 2008
Pheidole teneriffana Forel, 1893
Pheidole megacephala (Fabricius, 1793)
Tetramorium biskrense Forel, 1904
Tetramorium juba Collingwood, 1985
Tetramorium sericeiventre Emery, 1877
Tapinoma melanocephalum (Fabricius, 1793)
Tapinoma simrothi Krausse, 1911

Family Ichneumonidae (Ichneumon wasps or ichneumonids)

Ichneumonidae have two-segmented trochanters, horsehead cell visible in front wing (forewings lack a costal cell), females with a long, slender ovipositor, 16 or more segments in the antennae. This is a large family with many subfamilies and tribes. Ichneumonids are parasites of many insects, and therefore are good biological control agents for many insect pests. They do not sting. Four species were recorded from Kuwait: *Pimpla instigator* Fabricius, 1793, *Pimpla raborator* Fabricius, 1793*, Simophion calvus* Victorov, 1961 and *Tersilochus conotracheli* (Riley, 1871).

Family Mutillidae (Velvet ants)

Mutillidae are wasps but called “velvet ants” because the wingless females are antlike and covered with a dense pubescence. The males are larger than females, winged, and densely pubescent. The females have a very painful sting. Velvet ants are parasites of ground nesting bees and wasps. *Tricholabiodes semistra*, and *Tricholabiodes semistriatus* (Klug, 1829) were recorded from Kuwait.

Family Pompilidae (Spider wasps)

Pompilidae are typically, dark coloured with smoky or yellowish wings; a few are brightly coloured. They are slender with long and spiny legs, hind femora typically extending beyond tip of abdomen. They are parasites of spiders. The have a painful sting. Two were recorded from Kuwait: *Batazonellus lacerticida* (Pallas, 1771) and *Stolidia noscibilis* (Kohl, 1906).

Family Pteromalidae (Pteromalids)

Pteromalidae are morphologically and biologically diverse. The family is difficult to characterize, however, the tarsi are five-segmented, the antennal funicle with five or more segments, and the pronotum is constricted anteriorly in dorsal view (bell-shaped). Pteromalids are parasitoids on crop pests. Some species attack all insect stages. *Pachyneuron aeneum* Masi, 1929 was recorded from Kuwait.

Family Scoliidae (Scoliid wasps)

Scoliidae are large, hairy, usually black with a yellow band(s) on the metasoma. The larvae are external parasites of white grubs (larvae of Scarabaeidae). The adults are commonly found on flowers. Four species were recorded from Kuwait: *Megascolia flavifrons* (Fabricius, 1775), *Scolia flavifrons* Fabricius, 1775 (Figure 57), *Scolia erythrocephala* Fabricius, 1798 and *Campsomeriella thoracica* (Fabricius, 1787) (Figure 58 & 59).

Figure 57: *Scolia flavifrons* Fabricius, 1775 (Photo by A. Katbeh-Bader).

Figure 58: *Campsomeriella thoracica* (Fabricius, 1787), wings spread (Photo by A. Katbeh-Bader).

Figure 59: *Campsomeriella thoracica* (Fabricius, 1787), wings folded (Photo by A. Katbeh-Bader).

Family Sphecidae (Mud daubers and sand wasps)

The Sphecidae have the lateral margin of pronotum as a distinct lobe that does not touch the tegula. Body relatively devoid of hairs. Basal segment of tarsi not enlarged or flattened (similar to others). Abdomen often with a long petiole. These wasps provision nests with different kinds of insects. A total of 39 species were recorded from Kuwait (Table 12). *Bembix dahlbomi,* Handlirsch 1893 is shown in Figure (60) and *Prionyx niveatus* (Dufour, 1863) in Figure (61).

Table 12: Sphecidae of Kuwait.

Ammophila rubripes Spinola, 1838
Astata boops Schrank, 1781
Bembix dahlbomi Handlirsch, 1893
Bembix pallescens Priesner, 1958
Cerceris pulchella Klug, 1845
Cerceris straminea Dufour, 1854
Chlorion regale Smith, 1873
Dienoplug formosus Jurine, 1807
Diodontus friesci Kohl, 1901
Diodontus minutus (Fabricius, 1795)
Diodontus oraniensis (Lepeletier, 1845)
Dryudella bifasciata (Schulthess 1926)
Dryudella tricolor (Vander Linden, 1829)
Gastrosericus waltlii Spinola, 1838
Laphragogus pictus Kohl, 1889
Larra analis Fabricius, 1804
Liris agilis (Smith, 1856)
Miscophus pardoi Andrede, 1945
Oxybelus collaris Kohl, 1884
Oxybelus curviscutis Arnold, 1917
Oxybelus lamellatus Olivier, 1811
Palarus laetus Klug, 1845
Palarus saundersi (Morice, 1897)
Parapiagetia mongolica Morawitz, 1889

Parapsammophila turanica Morawitz, 1890
Philanthus genalis Kohl, 1891
Philanthus triangulum Fabricius, 1775
Philanthus variegatus Spinola, 1838
Podalonia ebenina (Spinola, 1838)
Podalonia minax (Kohl, 190I)
Padalonia tydei (Le Guillou, 1841)
Prionyx crudelis (Smith, 1856)
Prionyx niveatus (Dufour, 1863)
Prionyx macula (Fabricius, 1804)
Sphex argentatus Fabricius, 1785
Stizus marnonis Handlirsch, 1829
Stizus savignyi Spinola, 1838
Tachysphex grandissimus Gussakovskij, 1933
Tachysphex nitidus Spinola, 1805

Figure 60: *Bembix dahlbomi,* Handlirsch 1893 (Photo by A. Katbeh-Bader).

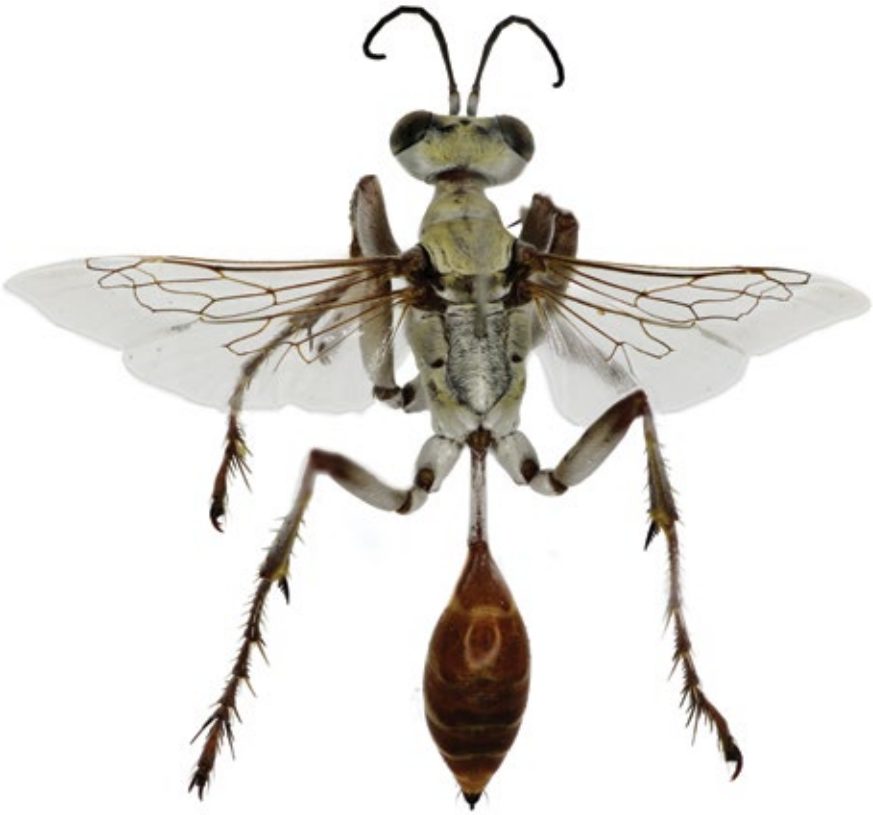

Figure 61: *Prionyx niveatus* (Dufour, 1863) (Photo by A. Katbeh-Bader).

Family Tiphiidae (Tiphiids)

Tiphiidae have the abdomenal segments often constricted. They are easily recognized by the platelike lamellae that extend over the bases of the middle coxae. Many species are black, hairy, with short, spiny legs. Tiphiidae are parasites of white grubs, tiger beetles, bees and wasps. *Iswara chobauti* (Andre, 1898) was recorded from Kuwait.

Family Vespidae (Paper wasps, yellow jackets, hornets, mason wasps, potter wasps)

Vespidae are mainly black with yellow, whitish or brownish markings. Some species are eusocial with queen, worker, and male casts. The queens and workers sting. The larvae in the nest are fed on insects and other animals.

Three species were recorded from Kuwait: *Pterocheilus fousti* (Morawitz, 1873), *Vespa orientalis* Linnaeus, 1771 (Figure 62) and *Polistes wattii* Cameron, 1900.

Figure 62: *Vespa orientalis* Linnaeus, 1771 (Photo by A. Katbeh-Bader).

3.13 Order Strepsiptera (Stylopids or twisted-wing parasites)

Members of order Strepsiptera are minute insects the parasitize on other insects. The males are winged and free-living, but the females are wingless and often legless. Males have protruding, raspberry-like eyes, and the antennae with elongate processes on some segments. The front wings are reduced to clublike structures like the halteres of the flies (Diptera). The hind wings are membranous, fanlike, with only longitudinal veins. Mengenillidae is the only family recorded from Kuwait.

Family Mengenillidae (Twisted-wing parasites)

The females in Mengenillidae are free-living and have a distinct head, with simple four- or five-segmented antennae, chewing mouthparts, and compound eyes. *Mengenilla arabica* Kinzelbach, 1979 was recorded from Kuwait.

3.14. Order Coleoptera

Order Coleoptera (beetles and weevils) includes about 400,000 known species and therefore is the largest order in the animal kingdom. It has as many different species as the entire plant kingdom, including Algae and Fungi. In the late 1800's, biologist J.B.S. Haldane reportedly was asked what his studies of the natural world revealed to him about God, Haldane replied: "An inordinate fondness for beetles". Almost half of the Earth's estimated 30 million insect species are beetles.

The largest of all families in this order is the Curculionidae (weevils) with some 70,000 species. *Scydosella musawasensis*, (Ptiliidae) is the smallest known beetle about 0.325 mm long while the Titan beetle, *Titanus giganteus*, a tropical longhorn beetle, is one of the largest (16.7 cm long) and heaviest insects in the world.

The name Coleoptera is taken from Coleo= sheath; ptera= wing (referring to the elytra). Elytra provide protection, and the ability to fold the flying wings which is one of the major reasons for their ability to live in different habitats. The mouthparts are of the chewing type. In the weevils, the front of the head is drawn out into a snout with the mouthparts at the end. The order includes five suborders, 24 superfamilies, 211 families, 541 subfamilies, 1,663 tribes and 740 subtribes.

Many coleopterans are phytophagous as free feeders on foliage or bore into wood or fruits or live as leaf miners. Other species are predaceous or feed on fungi. Some species are scavengers, and a few are parasitic. Many species feed on stored plant or animal products, including types of grains, clothing, wood, leather, and other organic materials. Many beetles are beneficial as biocontrol agents because they prey on insect pests. Many species are aquatic or semiaquatic.

The coleopteran fauna of Kuwait consists of 225 species belonging to 28 families. Al-Houty (1984) published the first list of Tenebrionidae from Kuwait. Other publications included records for beetles from Kuwait (Abushama & Cloudsley-Thompson, 1978; Al-Houty, 1997, 2004, 2011; Al-Houty & Angus, 1999; Penati & Vienna, 2006; Al-Khalifa et al., 2012). Species of the family Tenebrionidae were the most dominat with 69 species, followed by species in families the Meloidae (20 species) and Scarabaeidae (24 species). Endrödi and Al-Houty (1985) described *Pentodon kuwaitense* from Kuwait. Edmonds et al. (2019) added new records to the aquatic coleopteran of Kuwait.

Family Anobiidae (Death watch and spider beetles)

Anobiidae are cylindrical to oval, pubescent beetles, 1-9 mm long. The head is deflexed and is usually concealed from above by pronotum. Some species are common and destructive pests. Two species were recorded from Kuwait;

the drugstore beetle, *Stegobium paniceum* (L.) (Figure 63), which attacks various drugs and cereals; and the cigarette beetle, *Lasiodenna serricome* (Fabricius), which feeds on dried tobacco, insect collections, and stored products.

Figure 63: *Stegobium paniceum* (L.) (Photo by A. Katbeh-Bader).

Family Anthicidae (Antlike flower beetles)

Anthicidae are 2-12 mm long. They are antlike in appearance, with the head deflexed and strongly constricted behind the eyes, and oval pronotum. Some species have anterior hornlike process on the pronotum extending forward over the head. Beetles are found on flowers and foliage, under logs or stones, in debris, or on sand dunes. Two species were recorded from Kuwait. *Anthicus formicarius* (Goeze, 1777) and *Stricticomus goebeli* (Laferte, 1848), (cited as *Anthicus goebeli* (LaFerte-Senectere) by Al-Houty (2011).

Family Bruchidae (Seed beetles)

Bruchidae are short, stout, less than 5 mm long, with short elytra not covering the tip of abdomen. The body is often narrowed anteriorly and is usually dull grayish or brownish. The head is produced anteriorly into a short, broad snout. This family is considered in some references as a subfamily of Chrysomelidae. Four species were recorded from Kuwait. *Bruchus lentis* Forlich, 1799 *Callosobruchus maculatus* (Fabricius, 1775), *C. phaseoli* (Gyllenhal, 1833) and *Caryedon serratus* (Olivier, 1790).

Family Buprestidae (Metallic wood-boring beetles)

Buprestidae are often metallic coppery, green, blue, or black. They are hard-bodied and compactly built. Lateral sides of elytra almost parallel at first

two thirds, then converge posteriorly. Adults are attracted to dead or dying trees. Some species feed on leaves of shrubs and trees. Many of the larger beetles are common in sunny areas. Larvae are called flat-headed borers. Some are leaf or stem miners, others produce galls. Three species were recorded from Kuwait, *Steraspis speciosa* Klug, 1829, *Julodis distincta* Gory, 1840 *and Julodis speculifer* ssp*. dicksonae* (Théry, 1936).

Family Carabidae (Ground beetles)

Carabidae occur on the ground, a few will climb trees is search of prey such as snails or caterpillars. Most of them (larvae and adults) are active at night. Adults are omnivorous or predaceous. Few are pest species like the seed corn beetle. Carabids are important in ecological studies since they can be sampled by pitfall traps and results can be analyzed quantitatively and qualitatively. A total of 25 identified species were recorded from Kuwait (Table 13). The following six species are shown in Figures (64 to 69): *Anchomenus dorsalis* (Pontoppidan, 1763), *Anthia duodecimguttata* Bonelli, 1813, *Calosoma olivieri* Dejean, 1831, *Cymindis andreae* Menetries, 1831, *Graphipterus minutus* Dejean, 1822, and *Sphodrus leucophthalmus* (Linnaeus, 1758).

Table 13: Carabidae of Kuwait.

Acinopus megacephalus (P. Rossi, 1794) cited
Anchomenus dorsalis (Pontoppidan, 1763)
Amara glenni (Baliani, 1934)
Amara rufescens (Dejean, 1829)
Anthia duodecimguttata Bonelli, 1813
Bembidion saxatile Gyllenhal, 1827
Calosoma (*Caminara*) *imbricatum deserticola* Semenov, 1897
Calosoma olivieri Dejean, 1831
Calosoma sp.
Chlaenius koenigi Semjonoff, 1888
Cymbionotum semelederi (Chaudoir, 1861)
Cymindis andreae Menetries, 1831
Cymindis suturalis Dejean, 1825
Daptus acutus Reitter, 1893
Daptus vittatus Fischer, 1824
Diodercarus arrowi Lutshnik, 1931
Dyschirius beludscha Tschitscherine, 1904

Egaploa crenulata (Dejean, 1829)
Graphipterus minutus Dejean, 1822
Heteracantha depressa Brulle, 1834
Hypaetha singularis (Chaudoir, 1876)
Metabletus fuscomaculatus (Motschulsky, 1844)
Poecilus (*Ancholeus*) *wollastoni* (Wollaston, 1854)
Pogonus gilvipes Dejean, 1828
Sphodrus leucophthalmus (Linnaeus, 1758)

Figure 64: *Anchomenus dorsalis* (Pontoppidan, 1763) (Photo by A. Katbeh-Bader).

Figure 65: *Anthia duodecimguttata* Bonelli, 1813 (Photo by A. Katbeh-Bader).

Figure 66: *Calosoma olivieri* Dejean, 1831 (Photo by A. Katbeh-Bader).

Figure 67: *Cymindis andreae* Menetries, 1831 (Photo by A. Katbeh-Bader).

Figure 68: *Graphipterus minutus* Dejean, 1822 (Photo by A. Katbeh-Bader).

Figure 69: *Sphodrus leucophthalmus* (Linnaeus, 1758) (Photo by A. Katbeh-Bader).

Family Chrysomelidae (Leaf beetles)

Chrysomelidae are related to Cerambycidae, both with a similar tarsal structure and both are phytophagous. However, leaf beetles usually have much shorter antennae and are smaller and more oval than cerambycids. Leaf beetles occur on vegetation, both adults and larvae feed on living plants or plant remains. It includes many pests. It is a large family with 16 subfamilies. *Colaphellus apicalis* Ménétriés was recorded from Kuwait.

Family Cicindelidae (Tiger beetles)

Cicindelidae currently is considered as subfamily Cicindelinae of family Carabidae. Most tiger beetles are active in sunny situations. They are common on sandy beaches. They prey on small insects. The larvae are predaceous and live in vertical burrows in soil in dry paths or fields or in sandy beaches. Five species were recorded from Kuwait (Table 14).

Table 14: Cicindelidae of Kuwait.

Calomera alboguttata (Klug, 1832)
Calomera aulica (Dejean, 1831)
Cephalota zarudniana (Tschitscherine, 1903)
Cicindela littoralis Fabricius, 1787
Myriochile melancholica Fabricius, 1798

Family Cleridae (Checkered beetles)

Cleridae are elongate, very pubescent beetles 3-24 mm long, and many are brightly coloured. The pronotum is usually narrower than the base of the elytra and sometimes narrower than the head. They are important for attacking wood-boring beetles suppressing serious bark beetle outbreaks. Adults and larvae eat eggs, larvae, and adults of wood boring beetles. Some species live on flowers and foliage. So far, only *Necrobia rufipes* (Degeer) was recorded from Kuwait.

Coccinellidae (Ladybird beetles)

Coccinellidae are oval, convex, and often brightly coloured insects. The head is concealed from above by the expanded pronotum. They are the most beneficial of all beetles. All (larvae and adults) but few species prey on soft-bodied insects, typically aphids and scale insects, but some eat insect eggs and mites. They are common on vegetation where aphids feed in large numbers. Adults hibernate in large aggregations, under leaves, stones or in debris. Three species were previously reported from Kuwait, *Coccinella undecimpunctata* Reiche 1977, *C. septemdentatus* Linnaeus, 1758 and *Henosepilachna elaterii orientalis* Zimmermann, 1934.

Cryptophagidae (Silken fungus beetles)

Cryptophagidae are 1-5 mm long, elongate-oval in shape, yellowish brown, and covered with a silky pubescence. They feed on fungi or decaying vegetation. Some live in nests of bumble bees or wasps. So far, only *Cryptophagus cellaris* Scopoli was recorded from Kuwait.

Curculionidae (Snout beetles or weevils)

Curculionidae is the largest insect family worldwide. All are plant feeders, some are pests. Larvae feed on roots, stems, fruits, nuts, and seeds. Adults feed on leaves, pollen, flowers, fruit and fungi. Some are stored product insect pest such as the granary weevil, *Sitophilus granaries* (L.). Nine species were recorded from Kuwait (Table 15). The adult, cocoon, and larva of the red palm weevil, *Rhynchophorus ferrugineus* (Olivier, 1790), is shown in Figure 70.

Table 15: Curculionidae of Kuwait.

Ammocleonus aschabadensis (Faust, 1884)
Ammocleonus hieroglyphicus (Olivier, 1807)
Hypera brunnipennis (Boheman, 1834)
Hypera isabellina (Boheman, 1834)
Hypolixus nubilosus (Boheman, 1835)
Myllocerus arabicus Boheman, 1843
Rhynchophorus ferrugineus (Olivier, 1790)
Sitophilus oryzae (Linnaeus, 1763)
Sitophilus granarius (Linnaeus, 1758)

Family Cybocephalidae (Sap, bark, and fungus beetles)

Cybocephalidae are small beetles 1-3 mm long. They can roll into a ball like position facing their head downward. Many species prey on scale insects of the family Diaspididae. The family is sometimes considered as a subfamily of Nitudulidae. Three species are known to occur in Kuwait. *Cybocephalus mesopotamicus* Endrody-Younga 1968, *Cybocephalus rufifrons* Reitter, 1874 and *Trachelus tabidus* (Fabricius, 1775).

Dytiscidae (Predaceous diving beetles)

Dytiscidae are characterized by the antennae long and filiform, body oval smooth, streamlined, the hind legs flattened fringed with hairs. They are aquatic and good swimmers. Adults and larvae are carnivorous. A total of 21 species are known from Kuwait so far (Table 16). *Hygrotus confluens* (Fabricius, 1787) is shown in (Figure 71).

Figure 70: *Rhynchophorus ferrugineus* (Olivier, 1790), (top) adult, (middle) cocoon, (bottom) larva (Photos by A. Katbeh-Bader).

Table 16: Dytiscidae of Kuwait.

Agabus conspersus (Marsham, 1802)
Agabus solieri Aubé, 1837
Coelambus inscriptus Sharp, 1880
Colymbetes piceus Klug, 1834
Cybister lateralimarginalis (De Geer, 1774)
Cybister tripunctatus Castelnau, 1835
Eretes sticticus (Linnaeus, 1767)
Hydroglyphus signatellus (Klug, 1834)
Hydrovatus sp.
Herophydrus musicus (Klug, 1834)
Hygrotus enneagrammus (Ahrens, 1833)
Hygrotus confluens (Fabricius, 1787)
Hygrotus inscriptus (Sharp, 1882)
Hygrotus lernaeus (Schaum, 1857)
Hydroporus inscitus Sharp, 1882
Hydroporus planus (Fabricius, 1782)
Hyphoporus solieri (Aubé, 1838)
Laccophilus poecilus Klug, 1834
Lancetes lanceolatus (Clark, 1863)
Nebrioporus lanceolatus (Walker, 1871)
Rhantus suturalis (Macleay, 1825)

Figure 71: *Hygrotus confluens* (Fabricius, 1787) (Photo by A. Katbeh-Bader).

Dermestidae (Dermestid or skin beetles)

Dermestidae are recognized by the antennae being short and clubbed, the head is concealed from above, and has a pattern of sales on hairs on the elytra. Seven species are known from Kuwait (Table 17).

Table 17: Dermestidae of Kuwait.

Anthrenus coloratus Reitter, 1881
Anthrenus flavipes Le conte, 1854
Attagenusfaeiatus (Thunberg, 1795)
Attagenus lobatus Rosenhauer, 1856
Dermestes frisehii Kugelann, 1792
Dermestes vulpinus Fabricius, 1781
Phradonoma nobile (Reitter, 1881)

Family Elateridae (Clock beetles)

Elateridae are elongate, usually parallel-sided, and rounded at each end. The antennae usually serrate. They have a clicking mechanism between pro and meso sterna (ventral), and the posterolateral corners of pronotum are extended. The beetle can “click” and jump if turned on its back. Adults are phytophagous feeding on flowers, under bark, or on vegetation. Most larvae are slender, hard-bodied, and shiny and are called ‘wireworms’. Three species were recorded from Kuwait: *Aeoloides griseseens* Germar 1927, *Lanelater notodonta* (Latreille, 1827) and *Trogoderma granarium* Everts, 1898.

Family Gyrinidae (Whirligig beetles)

Gyrinidae are oval black beetles that are commonly seen swimming in endless circles on the surface of ponds and quiet streams. Their eyes are divided into two parts appearing as if they have four eyes, two above the water’s surface and two below the surface. They are the only aquatic beetles that regularly use the film on the water’s surface for support. They are skillful divers and when disturbed they secret defensive fluid. Adults are scavengers on insects that fall onto the water’s surface. Larvae are predaceous on small aquatic animals. Two species were recorded from Kuwait: *Dineutes grandis* Klug, 1834 and *Gyrinus distinctus* Aube, 1836.

Family Histeridae (Clown beetles or hister beetles)

Histeridae are small (0.5-1 0.0 mm long), broadly oval, shining black beetles. The elytra expose one or two apical abdominal segments. The antennae are elbowed and clubbed. They are found in or near dung, fungi, and carrion

preying on small insects living in these materials. Some very flat species live under loose bark. Eight species were recorded from Kuwait (Table 18).

Table 18: Histeridae of Kuwait.

Carcinops 14-striata (Stephens, 1835)
Geomysaprinus goffi Ross, 1940
Saprinus ehaleites (Illiger, 1807)
Saprinus ornatus Erichson, 1834
Saprinus uvarovi Muller, 1954
Saprinus (Saprinus) moyses Marseul, 1892
Pholioxenus mesopotamicus Olexa, 1984
Paravolvulus syphax (Reitter, 1904)

Family Helophoridae (Grooved water scavenger beetles)

Helophoridae can easily be distinguished from other members of the aquatic Coleoptera by the presence of its five longitudinal furrows on the pronotum. Only *Helophorus angus*tatus Motschulsky was recorded from Kuwait.

Family Hydraenidae (Minute moss beetles)

Hydraenidae are elongate or oval, dark-coloured beetles, 1.2-1.7 mm long. They are similar to Hydrophilidae but differ in having six or seven abdominal sterna, whereas there are only five in the Hydrophilidae. Both larvae and adults feed on algae along stream margins or the seashore. Three species were recorded from Kuwait. *Ochthebius notabilis* Rosenhauer, 1856, *Ochthebius punctatus* Stephens, 1829 and *Ochthebius zugmayeri* Kniz, 1909.

Family Hydrophilidae (Water scavenger beetles)

Hydrophilidae are oval convex beetles, with short, clubbed antennae and the long maxillary palps, some species have a sharp spine prolonged posteriorly on the metasternum. Most species are aquatic and like dytiscids. Up to now, 16 species have been recorded from Kuwait (Table 19).

Family Meloidae (Blister beetles)

Meloidae are usually narrow and elongate beetles, with soft and flexible elytra, and the pronotum is narrower than either the head or the elytra. They are called ‘blister beetles’ because they secrete a defensive fliud (cantharadin) that causes blisters when comes in contact with skin. Twenty species were recorded from Kuwait (Table 20).

Family Nitidulidae (Sap beetles)

Nitidulidae are elongate or oval. Elytra are usually short exposing the terminal abdominal segment. Antennal club usually 3segmented. Sap beetles are found on plant fluids oozing from decaying fruits, flowers, carcasses or dead animals, and under loose bark. Four species were recorded from Kuwait: *Carpophilus freemani* Dobson, 1956, *Carpophilus hemipterus* (Linnaeus, 1758), *Nitidula ciliata* Erichson, 1843 and *Urophorus humeralis* (Fabricius, 1798).

Table 19: Hydrophilidae of Kuwait.

Berosus asiaticus Kuwert, 1888
Berosus bispina Reiche & Saulcy, 1856
Berosus insolitus d'Orchymont, 1937
Berosus spinosus Steven, 1808
Enochrus bicolor Fabricius, 1792
Enochrus ater (Kuwert, 1888)
Enochrus segmentinotatus (Kuwert, 1888)
Enochrus sinuatus d'Orchymont, 1937
Enochrus (*Lumetus*) *politus* (Küster, 1849)
Enochrus (*Methydrus*) sp.
Hydrochara flavipes (Steven, 1808)
Hydroporus angustatus Sturm, 1835
Hydrophilus aculeatus Solier, 1834
Paracymus relaxus Rey, 1884
Paracymus aeneus (Germar, 1824)
Sternolophus solieri (Castelnau, 1840)

Table 20: Meloidae of Kuwait.

Coryna dentieulata Marseul, 1871
Croseheriehia litigiosa (Chevrolat, 1840)
Croseheriehia nigriplantis (Klug, 1845)
Croseheriehia sanguinolenta (Olivier, 1811)
Croseheriehia tigrinipennis (Latreille, 1823)
Croscherichia vigintipunctata (Olivier, 1811)
Cylindrothorax angustieollis Kaszab, 1955
Cylindrothorax buettikeri Kaszab, 1983

Cylindrothorax palastinus (Kirsch, 1870)
Decapotoma argentifera Kaszab, 1969
Diaphoroeera hempriehi Kaszab, 1983
Diaphoroeera johnsoni Kaszab, 1983
Hycleus talhouki (Kaszab, 1983)
Lyttolydulus thiebaulti Kaszab, 1983
Lyttonyx bicolor (Walker, 1871)
Meloe omanicus Kaszab, 1983
Mylabris brunnipes Klug, 1845
Mylabris calida (Pallas, 1782)
Mylabris elegans Olivier, 1811
My1abris semifasciata Pic, 1895

Family Scarabaeidae (Scarab beetles)

Scarabaeidae are stout, oval, or elongate, usually convex beetles, with the tarsi 5-segmented, and 8-llsegmented and lamellate antennae. The last three segments (rarely more) of the antennal segments are expanded sideways into platelike structures. Scarab beetles feed on dung, decomposing plant materials, fungi, leaves, fruits, flowers, or carrion. Some species are found in burrows of vertebrates or in ants or termtes nests. Larvae are C-shaped and called ‘white grubs’ which may become important plant pests. Up to now, 26 species have been recorded from Kuwait (Table 21). *Tropinota squalida* (Scopoli, 1783) is shown in (Figure 72).

Table 21: Scarabaeidae of Kuwait.

Aphodius arabicus Harold, 1875
Aphodius assectators Balthasar, 1961
Aphodius klugi Schmidt, 1910
Aphodius lividus (Olivier, 1789)
Aphodius luciolus Klug, 1845
Aphodius pruinosus Reitter, 1892
Aphodius wollastoni Harold, 1862
Eremazus unistriatus Mulsant, 1851
Hybosorus illigeri Reiche, 1853
Gymnopleurus mopsus Pallas, 1781

Onthophagus tripolitanus Heyden, 1890
Oryctes agamemnon (Burmeister, 1847)
Pentodon kuwaitensis Endrödi & Houty, 1985
*Pentodon algeriu*m (Herbst, 1789)
Rhyssemus granosus Klug & Erichson, 1842
Podalgus cuniculus Burmeister, 1847
Phyllognathus excavates (Forster, 1771)
Polyphylla fullo (Linnaeus, 1758)
Mnematium silenus (Gray, 1832)
Mnematium rotundipenne (Holdhaus, 1919)
Scarabaeus acuticollis Motschulsky, 1849
Scarabaeus cristatus Fabricius, 1775
Scarabaeus irakensis Stolfa, 1938
Scarabaeus bannuensis Janssens, 1940
Scarabaeus sacer Motschulsky, 1849
Tropinota squalida (Scopoli, 1783)

Figure 72: *Tropinota squalida* (Scopoli, 1783) (Photo by A. Katbeh-Bader).

Family Silvanidae (Silvanid flat bark beetles)

Silvanidae have long, slender, sometimes capitate antennae, constricted head behind the eyes, all tarsi 5-segmented. The family is similar to Cucujidae, and previously it had been a part of it. It is mainly a tropical family. *Oryzaephilus surinamensis* (L.) (Figure 73), was recorded from Kuwait. It is a worldwide stored product pest of grains and grain products, chocolate, drugs, and tobacco.

Figure 73: *Oryzaephilus surinamensis* (L., 1758) (Photo by A. Katbeh-Bader).

Family Spercheidae (Filter-feeding water beetles)

Spercheidae are a small family of aquatic beetles with the head strongly contracted behind the eyes, a widely dilated dimorphic clypeus, a large and transverse mentum. They are found in lentic habitats rich in vegetation, or in the mud at the edges of pools. Adults and larvae are filter feeders but neither stage can swim. *Spercheus belli babylonicus* (Hebauer, 1990) was recorded from Kuwait.

Family Staphylinidae (Rove beetles)

Staphylinidae are slender, elongate, with short elytra exposing some abdominal segments, mainly black or brown. They are good fliers. When they run, they raise the tip of their abdomen as do scorpions. Rove beetles are found under stones, on dung or carrion, along the shores of streams and the seashore, in leaf litter or fungi, in nests of birds, mammals, ants, and termites. Adults and larvae are predaceous and share the same habitat. Six species have been recorded from Kuwait (Table 22).

Table 22: Staphylinidae of Kuwait.

Bledius capra Fauvel, 1875
Gabronthus maritimus Motschulsky, 1858
Paederus fuscipes Curtis, 1826
Philonthus quinquilarius (Gyllenhal, 1810)
Philonthus irakoiraniens (Scheerp, 1961)
Scopaeus infirmus (Erichson, 1840)

Family Tenebrionidae (Darkling beetles)

Tenebrionidae have 5-5-4 tarsal fonnula, the eyes usually notched, the antennae nearly always 11segmented, with five visible abdominal sterna. Most species are black or brownish. Typically, they feed on plant materials, and a few are stored grain or flour pests. The subfamily Alleculinae (the comb-clawed beetle) is made up of a shining beetle found on flowers or leaves, on fungi, and under dead bark. A total of 69 species were recorded previously from Kuwait (Table 23). Twenty species are shown in figures 74 to 81.

Table 23: Tenebrionidae of Kuwait.

Adesmia aenescens Kuhnelt, 1951
Adesmia cancellata (Klug, 1830)
Adesmia carinata Solier, 1835
Adesmia cothurnata Schatzmayer & Koch, 1934
Adesmia lacunosa (Klug, 1830)
Adesmia stockleini Koch, 1940
Akis elevata Solier, 1836
Alphitobius diaperinus (Panzer, 1797)
Ammogiton buettikeri Kaszab, 1979
Anemia asperula Reitter, 1884
Anemia bidentula Fairmaire, 1892
Anemia brevicollis Wollaston, 1864
Anemia chobauti Reitter, 1898
Anemia cornuta Pic, 1898
Apentanodes arabicus (Kirchsberg, 1877)

Apentanodes buettikeri Kaszab, 1979
Apentanodes globosus (Reiche & Saulcy, 1857)
Belopus csikii Reitter, 1920
Blaps batesi Allard, 1880
Blaps kollari Seidlitz, 1896
Blaps mortisaga (Linnaeus, 1758)
Blaps polychresta Forskol, 1775
Blaps taeniolata Ménétriése, 1832
Blaps wiedemanni Solier, 1848
Clitobius oblongiusculus (Fairmaire, 1875)
Crypticus maculosus Fairmaire, 1870
Cyphostethe ferruginea (Marseul, 1867)
Erodius octocostatus Peyerimhoff, 1907
Erodius rubalkhalianus Kaszab, 1981
Erodius sauditus Kaszab, 1981
Erodius servillei Solier, 1834
Gedeon hierichonticus Reiche & Saulcy, 1857
Gonocephalum besnardi Kaszab, 1982
Gonocephalum prolixum (Erichson, 1843)
Gonocephalum setulosum (Faldermann, 1837)
Gonocephalum simplex (Fabricius, 1801)
Lobodera oblongopunctata Reitter, 1904
Mesostena arabica (Gestro, 1881)
Mesostena puncticollis Solier, 1835
Mesostena rathjensi (Gebien, 1938)
Micipsa arabica Kaszab, 1981
Microtelus careniceps Kaszab, 1982
Opatroides punctulatus Brulle, 1832
Oxycara buettikeri Kaszab, 1979
Oxycara ardoini (Kaszab, 1979)

Paraplatyope arabica (Blair, 1931)
Pimelia ardiani Reitter, 1915
Pimelia arabica Klug, 1830
Pimelia longula Kwieton, 1981
Pimelia schusteri Reitter, 1915
Pimelia zhenzhurist Bogatshev, 1953
Prionotheca coronata ovalis Ancey, 1881
Scaurus punticollis Solier, 1836
Scleron sulcatum Baudi, 1876
Sepidium mesopotamicum Reitter, 1914
Storthocnemis saudita Koch, 1965
Tentyrina palmeri (Crotch, 1872)
Tentyrina deserta Kaszab, 1981
Thriptera crinita (Klug, 1830)
Trachyderma hespida (Forskoll, 1775)
Trachyderma philistina Reiche & Saulcy, 1857
Trachyderma parvicollis Baudi, 1875
Tribolium castaneum (Herbst, 1797)
Tribolium confusum Jacquelin, 1868
Tribolium destructor Uyttenboogart, 1933
Trichosphaena arabica Kaszab, 1961
Vieta tuberculata Solier, 1843
Zophosis complanata Solier, 1834
Zophosis punctata medicoris Deyrolle, 1867

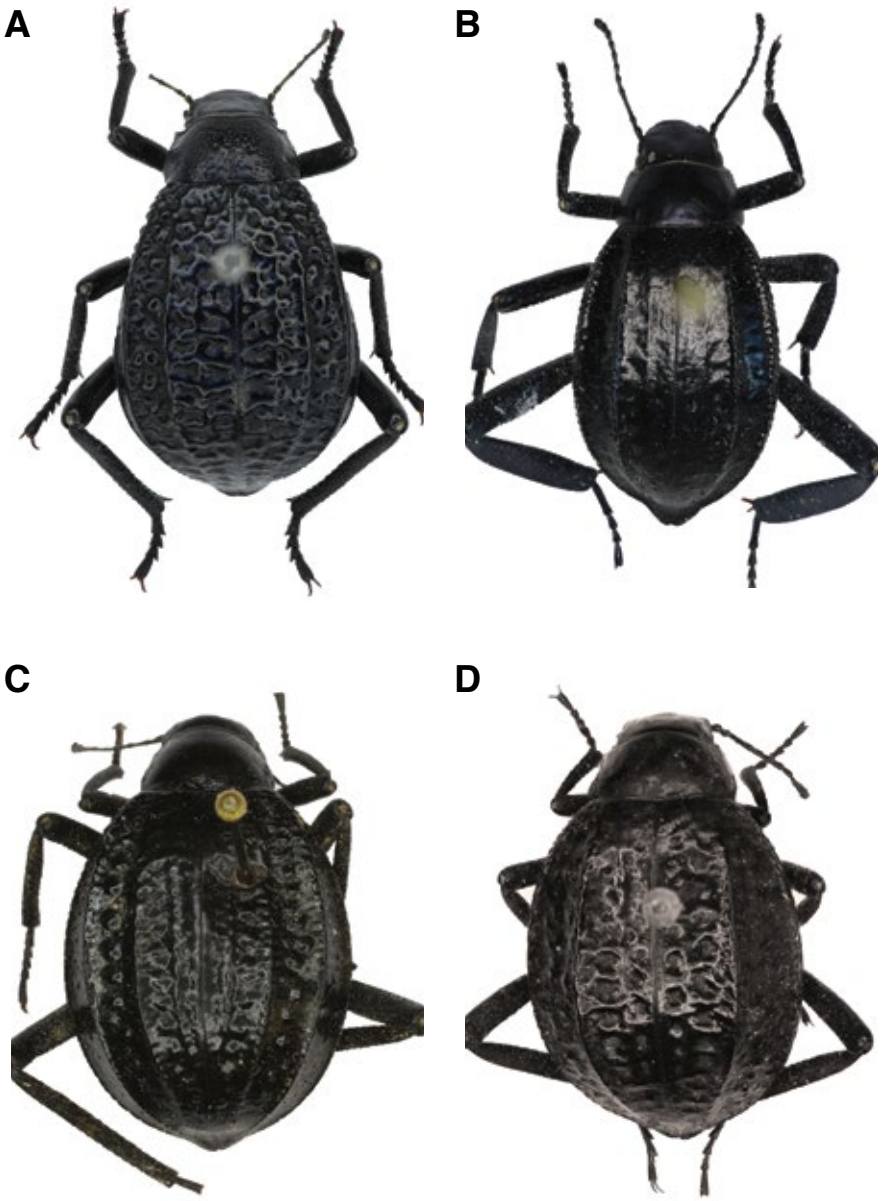

Figure 74: A. *Adesmia cancellata* (Klug, 1830) B. *Adesmia carinata* Solier, 1835. C. *Adesmia cothurnata* Schatzmayer & Koch, 1934 D. *Adesmia stockleini* Koch, 1940 (Photos by A. Katbeh-Bader).

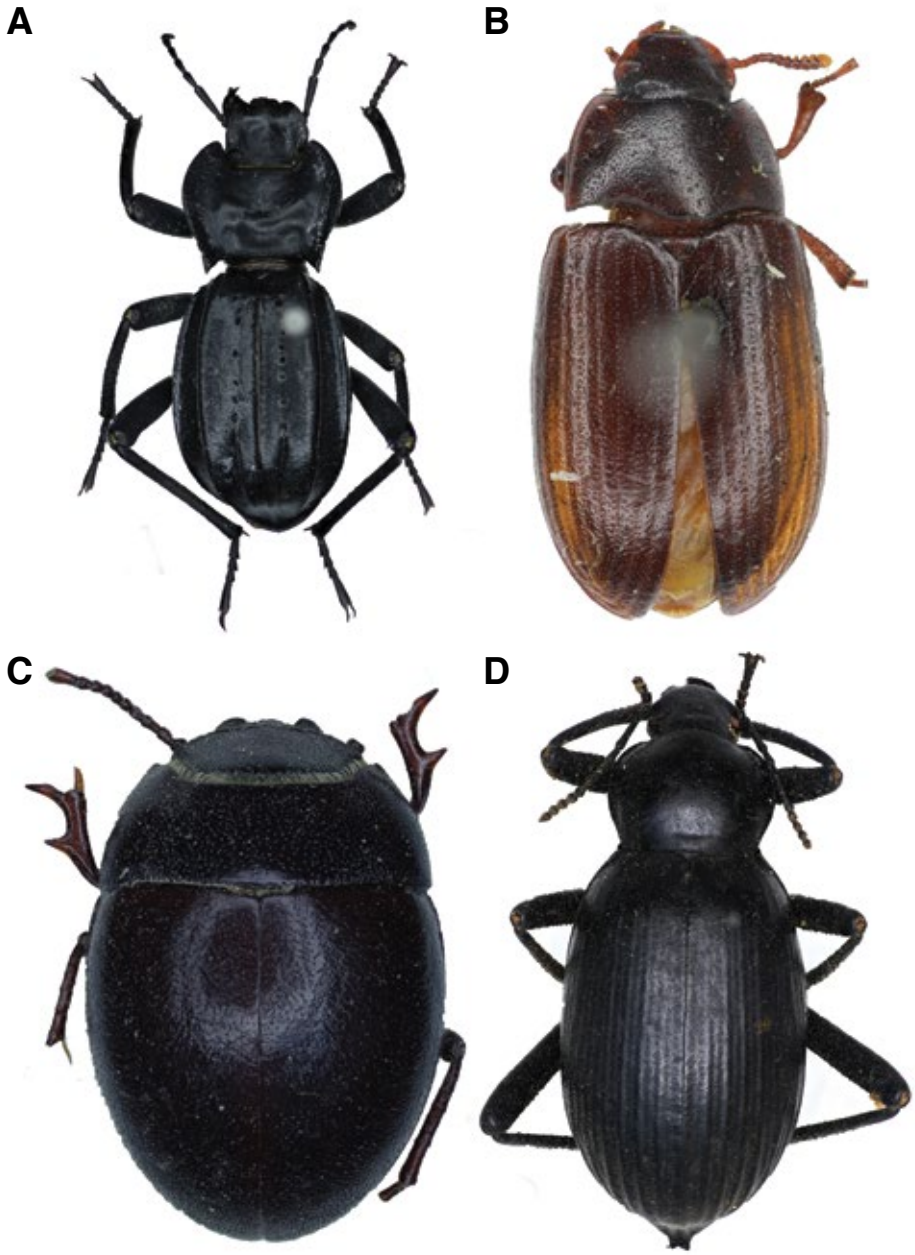

Figure 75: A. *Akis elevata* Solier, 1836 B. *Alphitobius diaperinus* (Panzer, 1797) C. *Apentanodes arabicus* (Kirchsberg, 1877) D. *Blaps kollari* Seidlitz, 1896 (Photos by A. Katbeh-Bader).

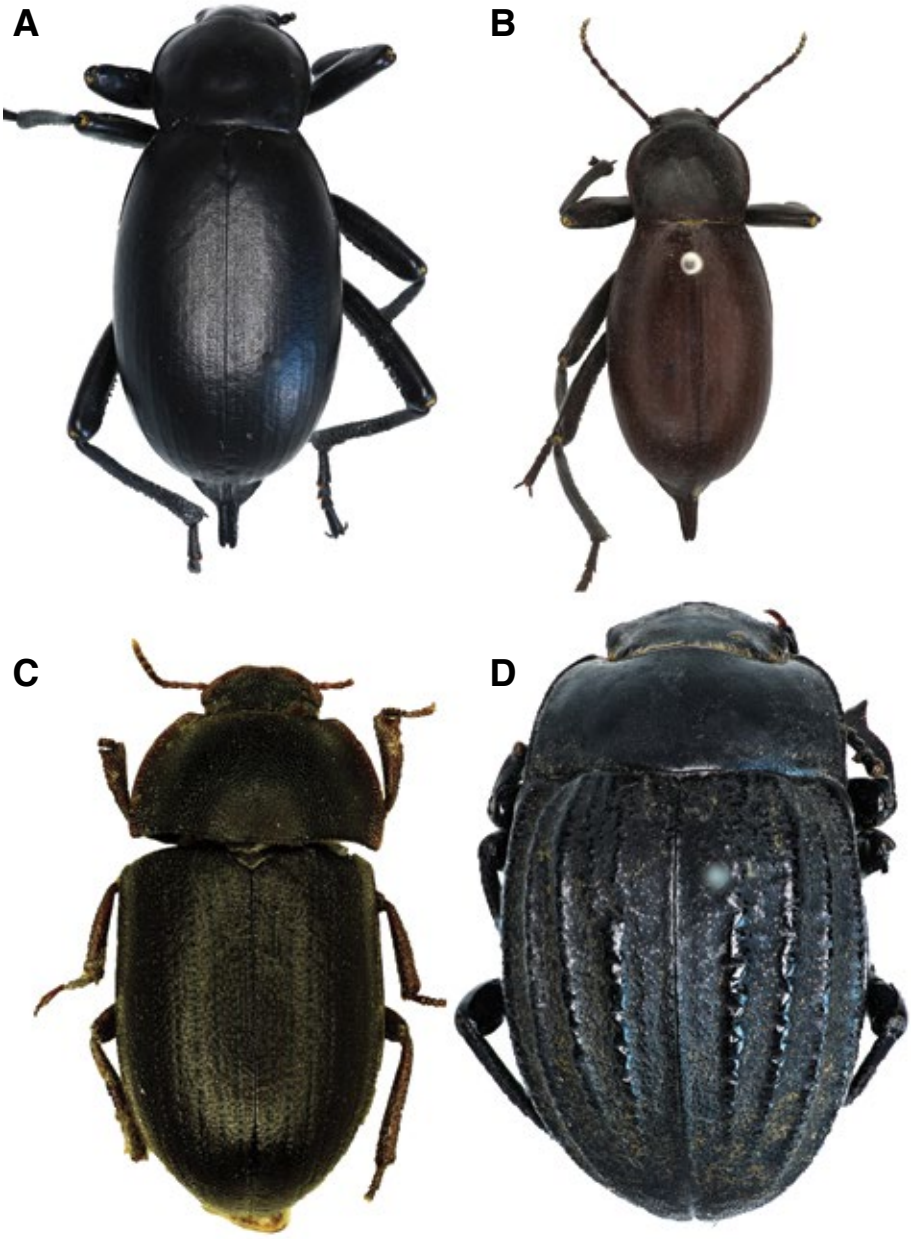

Figure 76: A. *Blaps polychresta* Forskol, 1775 B. *Blaps taeniolata* Ménétriése, 1832 C. *Clitobius oblongiusculus* (Fairmaire, 1875) D. *Erodius octocostatus* Peyerimhoff, 1907 (Photos by A. Katbeh-Bader).

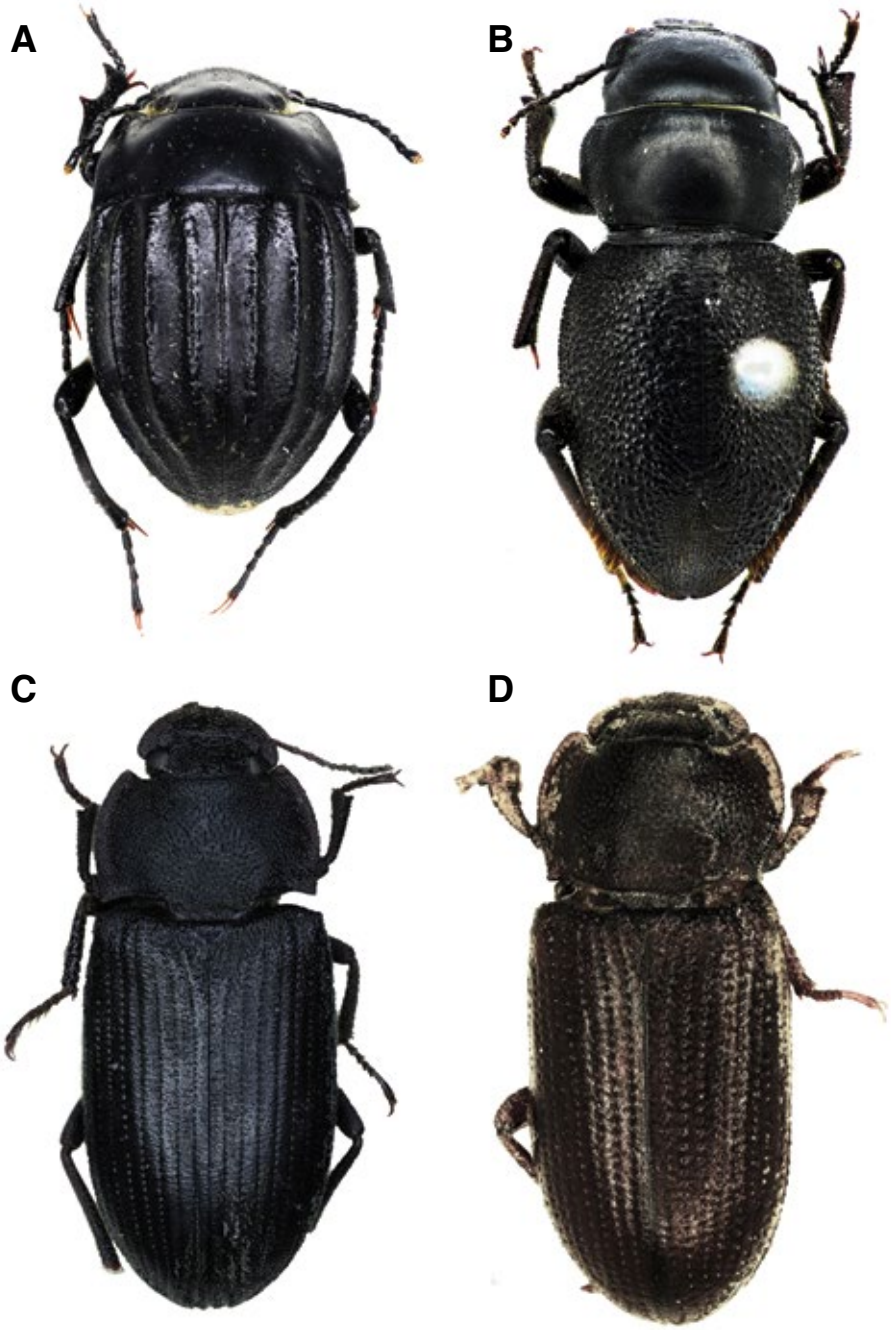

Figure 77: A. *Erodius sauditus* Kaszab, 1981 B. *Gedeon hierichonticus* Reiche & Saulcy, 1857 C. *Gonocephalum prolixum* (Erichson, 1843) D. *Gonocephalum setulosum* (Faldermann, 1837) (Photos by A. Katbeh-Bader).

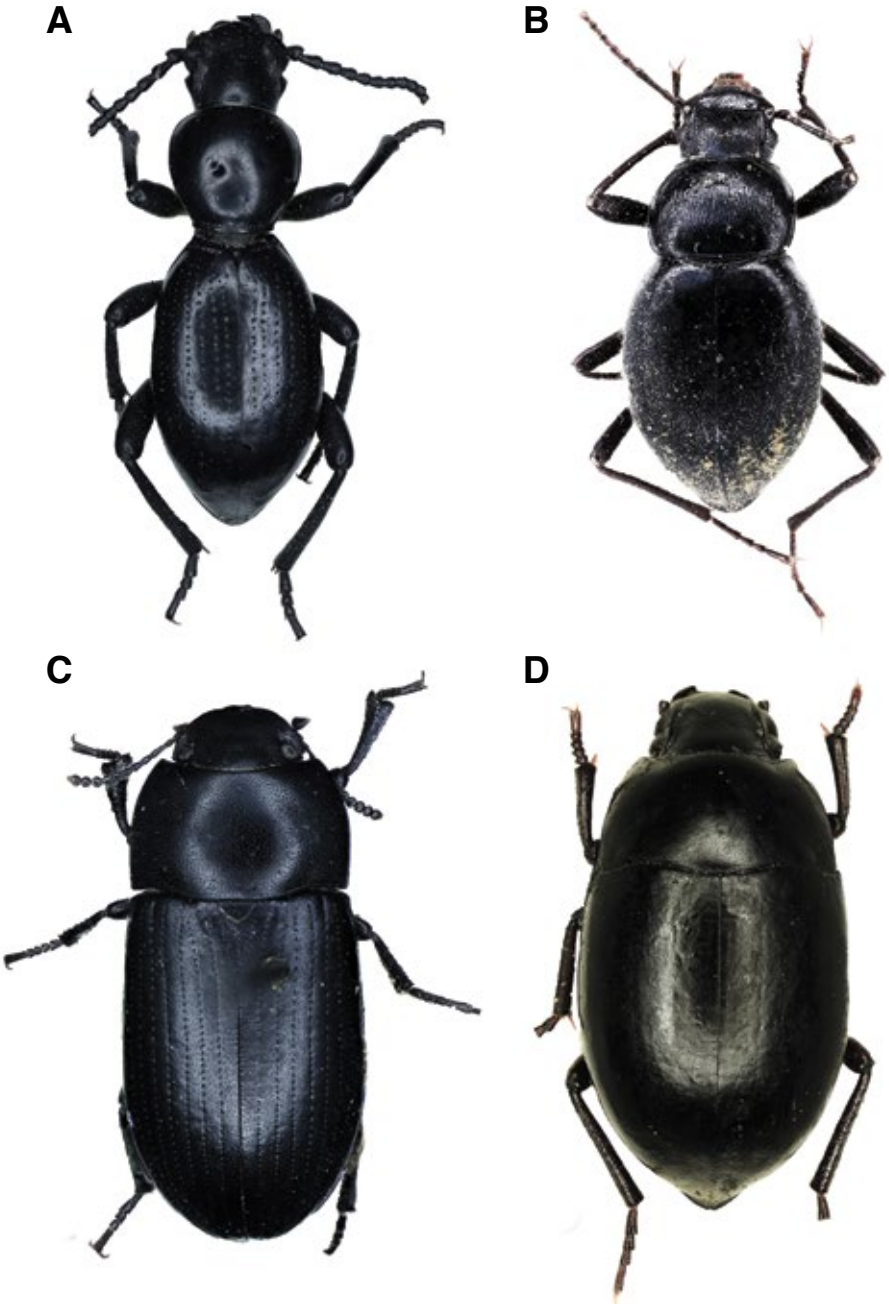

Figure 78: A. *Mesostena puncticollis* Solier, 1835 B. *Micipsa arabica* Kaszab, 1981 C. *Opatroides punctulatus* Brulle, 1832 D. *Oxycara ardoini* (Kaszab, 1979) (Photos by A. Katbeh-Bader).

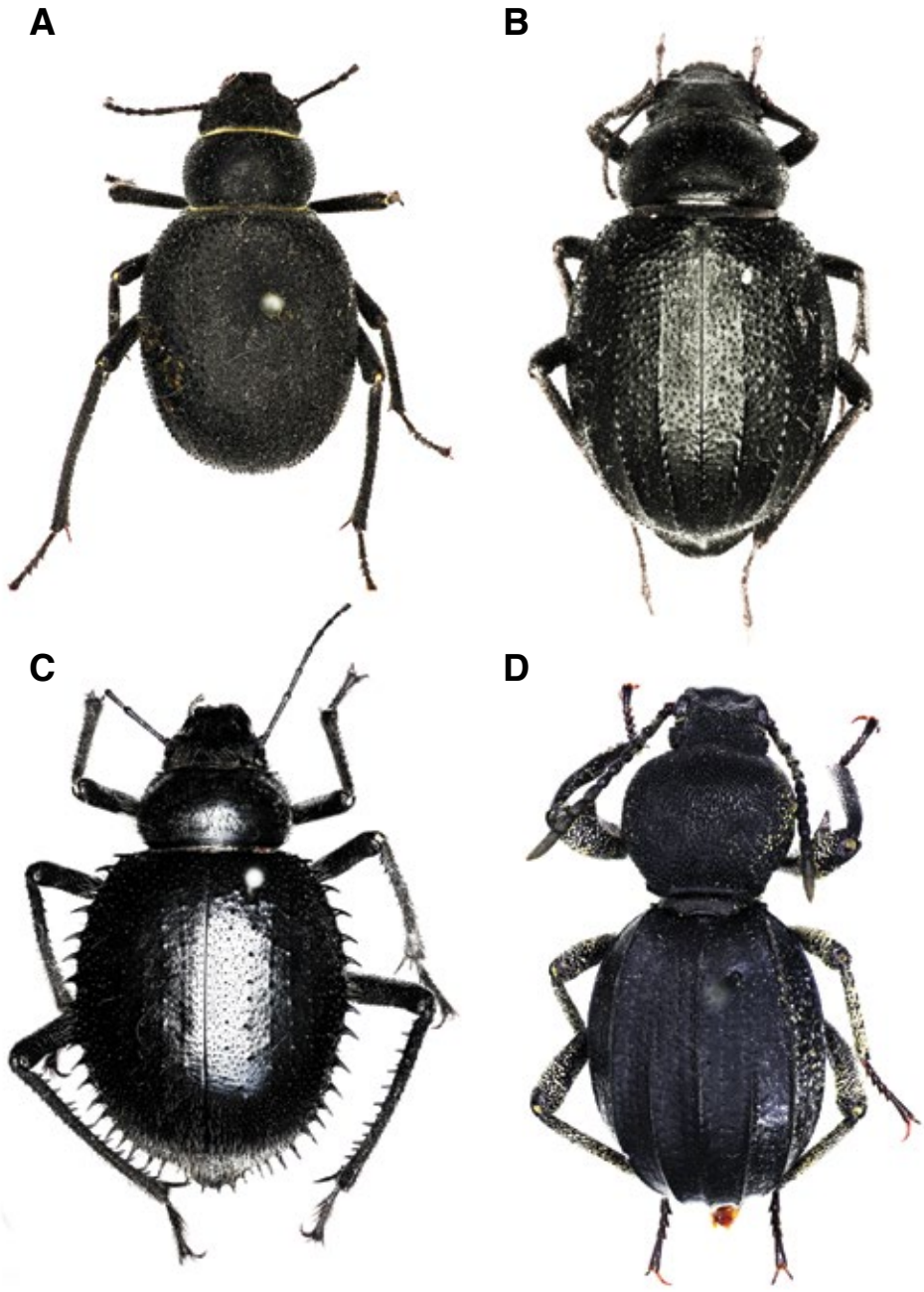

Figure 79: A. *Pimelia ardiani* Reitter, 1915 B. *Pimelia arabica* Klug, 1830 C. *Prionotheca coronata ovalis* Ancey, 1881 D. *Scaurus punticollis* Solier, 1836 (Photos by A. Katbeh-Bader).

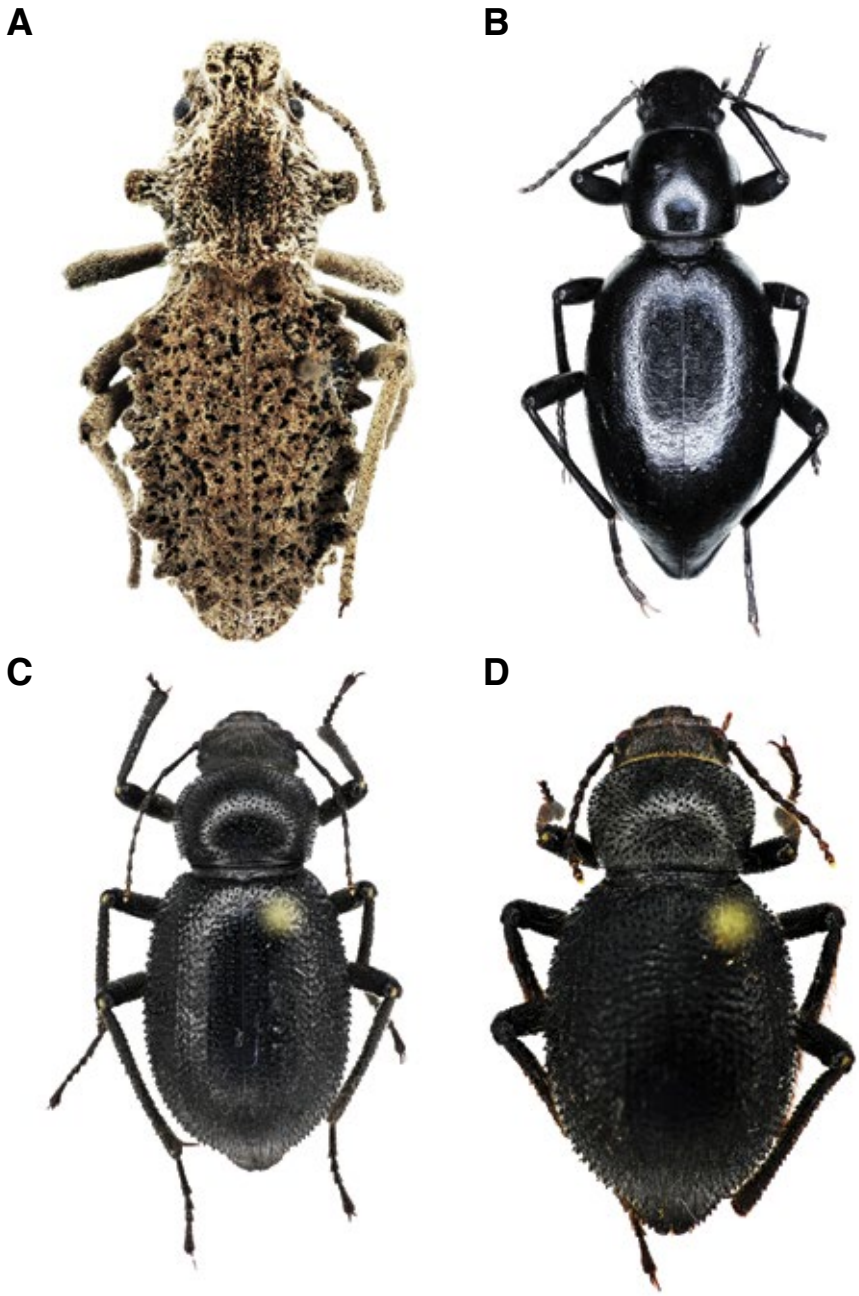

Figure 80: A. *Sepidium mesopotamicum* Reitter, 1914 B. *Tentyrina palmeri* (Crotch, 1872) C. *Trachyderma hespida* (Forskoll, 775) D. *Trachyderma philistina* Reiche & Saulcy, 1857 (Photos by A. Katbeh-Bader).

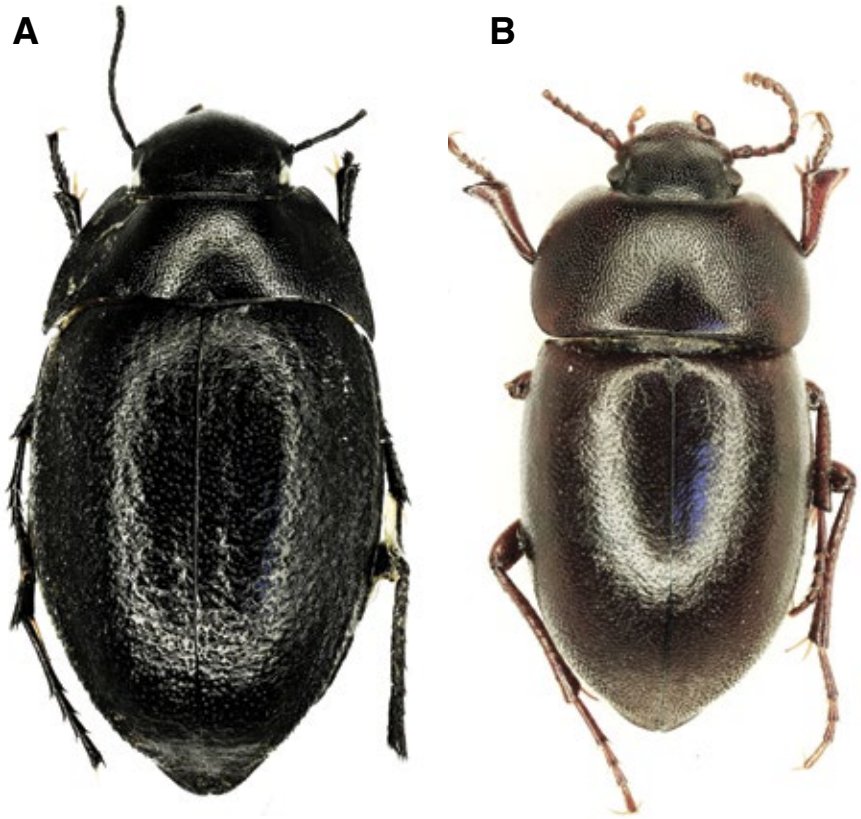

Figure 81: A. *Zophosis complanata* Solier, 1834 B. *Zophosis punctata medicoris* Deyrolle, 1867 (Photos by A. Katbeh-Bader).

3.15 Order Neuroptera

Order Neuroptera known as the net-winged insects, includes lacewings, mantidflies, antlions, and their relatives, with apporximately 6,000 species worldwide. Records from Kuwait were extracted from Meinander (1980), Al-Houty (1997: 2011) and Canard and Thierry (2014), with a total of 14 species.

Family Chrysopidae (Common lacewings, green lacewings)

Chrysopidae are usually green, with a single distinct radial sector. Adults and larvae are predators on aphids, whiteflies, mealybugs and other small insects. They are considered important natural or biological control agents for many agricultural pests. They are usually attracted to light at houses during spring and summer. Four species were recorded from Kuwait. *Chrysoperla carnea* (Stephens, 1836) (Figure 82), *Chrysoperla concinna* (Holzel, 1974), *Chrysoperla mutata* (Mclachlan, 1898) and *Suarius tigridis* (Morton, 1921).

Figure 82: *Chrysoperla carnea* (Stephens, 1836)

Family Myrmeleontidae (Antlions)

Myrmeleontidae have a long slender abdomen. They resemble damselflies but have a softer body, longer, clubbed antennae and different wing venation. They are weak fliers and are often attracted to lights. Some species have clear wings while others may be irregularly spotted. Nine species have been recorded from Kuwait so far (Table 24).

Table 24: Myrmeleontidae of Kuwait.

Creoleon aegyptiacus (Rambur, 1842)
Creoleon cervinus Holzel, 1983
Creoleon pullus Holzel, 1983
Creoleon ultimus Holzel, 1983
Creoleon cinereus Kimmins, 1943
Gepella modesta Holzel, 1968
Myrmeleon hyalinus Olivier, 1811
Nophis teillardi Navas, 1912
Quinemurus cinereus Kimmins, 1943

Family Nemopteridae (Thread-winged antlions)

have the hind wings elongated and ribbon-like, sometimes spatulate. They are weak fliers. *Halter halteratus* (Forskål, 1775) was recorded from Kuwait.

3.16 Order Trichoptera

Trichoptera (Caddisflies) is a large order of aquatic insects. Larvae and pupae are mainly aquatic, and a few are terrestrial or marine. Adults are terres-

trial, moth-like with two pairs of wings (one species has wingless or winged females). Most caddisflies are dull-coloured insects, but a few are conspicuously patterned. The mouthparts are of the chewing type, with the palps well developed but with the mandibles much reduced. The adults feed principally on liquid foods. Adults are usually crepuscular, with a larger peak shortly after dusk than just before sunrise, some species are nocturnal. Mating occurs in flight, on ground or on vegetation. Females usually oviposit in or near the water shortly after mating. Case and retreat making is an important behavior in the larvae of this insect order. The ability to secrete silk has led to a variety of shelters and food capturing devices which enable them to exploit a wide range of lentic and lotic habitats.

Family Leptoceridae (Long-horned caddisflies)

Leptoceridae are slender, often pale-coloured with long, slender antennae that are often nearly twice the body length. The larvae live in a variety of habitats and make diffetent kinds of cases. *Ylodes reuteri zarudnyi* McLachlan, 1880 is found in Kuwait.

3.17 Order Lepidoptera (Butterflies and moths)

Butterflies and moths are common insects, and many are beautifully coloured and collected by amateur as well as professional entomologists. Approximately 180,000 species of this order are described in 126 families (Capinera, 2008). Members of this order have four membranous wings, but some species are wingless. Wings are largely or entirely covered with scales. Mouthparts are of the sucking type with a proboscis usually in the form of a coiled tube. Some species have vestigial mouthparts and do not feed as adults. Mandibles are nearly always vestigial or lacking (except Zeugloptera). The labial palps usually are well developed and conspicuous while the maxillary palps are generally vestigial or lacking. Antennae long, slender, always knobbed apically in butterflies. Adults feed principally on nectar and other liquid food. In the family Micropterigidae (Suborder Zeugloptera), adults use mandibles to crush and eat pollen. Some families have auditory organs (tympana) that detect the high-frequency echolocating sounds of bats. Characteristics used in the classification of Lepidoptera are the wing venation, mouthparts, antennae, presence or absence of a frenulum (a bristle or group of bristles at the humeral angle of hindwing), ocelli, characteristics of legs and genitalia. A pictured key could be used to identify many species. However, some species can be positively identified only by the examination of the male genitalia.

Butterflies and moths of Kuwait were extensively studied (Brown, 1970; Al-Houty, 1983, 1995, 1997, 2011). Butterflies of Kuwait conists of 22 species in five families. Additional record of *Brephidium exilis* was reported from Sabah Al Ahmad Sea City (Pope & Nithyanandan, 2014). A total of 68 species of

moths belonging to eight families have been recorded from Kuwait (Table 38). Family Noctuidae has the highest number of species with 43 species (Al-Houty, 1983, 1995, 1997. 2011).

Family Danaidae (Milkweed butterfly)

Danaidae are large and brightly coloured butterflies, usually brownish with black and white markings. Front legs are small and not used in walking. The larvae feed on milkweed. Family Danaidae is considered by some taxonomists as a subfamily of Nymphalidae. The Plain tiger, *Danaus chrysippus* (Linnaeus 1758) (Figure 83 A), was recorded from Kuwait.

Family Pieridae (Whites, sulphurs, and orangetips)

Pieridae are medium to small butterflies, usually white or yellowish in colour with black marginal wing markings. The front legs are well developed, with bifid tarsal claws. The radius in the front wing has 3–5 branches. Nine species have been recorded from Kuwait (Table 25). *Artogeia rapae* Schawerda, 1905 is shown in Figure (83 B), *Euchloe belemia* (Esper, 1799) in Figure (83 C&D), and *Madais fausta* (Oliver, 1804) in Figure (83 E).

Table 25: Pieridae of Kuwait.

Common name	***Scientific name***
Pioneer white	*Anaphaeis aurota* (Fabricius, 1793)
Small white butterfly	*Artogeia rapae* Schawerda, 1905
Clouded yellow	*Colias croceus* Pieridae Geofroy, 1785
Eastern pale clouded yellow	*Colias erate marnoana* Rogenhofer, 1883
Green-striped white	*Euchloe belemia* (Esper, 1799)
Salmon Arab	*Madais fausta* (Oliver, 1804)
African clouded yellow	*Colias electo* (Linnaeus, 1763)
Desert white	*Pontia glauconome* (Klug, 1829)

Family Nymphalidae (Brush-footed butterflies)

Nymphalidae have their front legs very much reduced and lack claws, and only the middle and hind legs are used in walking. Five species have been recorded from Kuwait (Table 26). *Vanessa atalanta* (Linnaeus, 1758) is shown in Figure (83 F) and *Vanessa cardui* Linnaeus, 1758 in Figure (83 H).

Table 26: Nymphalidae of Kuwait.

Common name	Scientific name
Blue pansy	*Junonia orithya* (Riley, 1925)
Red admiral	*Vanessa atalanta* (Linnaeus, 1758)
Common evening brown	*Melanitis leda* Linnaeus, 1758
Painted lady	*Vanessa cardui* Linnaeus, 1758
Danaid eggfly	*Hypolimnas misippus* (Linnaeus, 1764)

Family Lycaenidae (Coppers, hairstreaks, blues, harvesters and metalmarks)

Lycaenidae are small, delicate, and often brightly coloured butterflies. The body is slender, the antennae are usually ringed with white, and a line of white scales encircles the eyes. Five species have been recorded from Kuwait (Table 27).

Table 27: Lycaenidae of Kuwait.

Common name	Scientific name
Long-tailed blue	*Lampides boeticus* (Linnaeus, 1767)
Little tiger blue	*Tarucus ballkanicus* (Freyer, 1844)
Mediterranean pierrot	*Tarucus rosaceus* (Austaut, 1885)
Dark grass blue	*Zizeeria karsandra* (Moore, 1865)
Western pygmy blue butterfly	*Brephidium exilis* (Boisduval, 1852)

Family Papilionidae (Papilionidae-Swallowtails and Parnassians)

Papilionidae have a second anal vein, which extends up to the wing margin but does not link with the first anal vein. These veins are fused in other butterfly families and second anal vein does not reach the wing margin. Two species have been recorded from Kuwait: The Lime Swallowtail, *Papilio demoleus* (Linnaeus, 1764), and the Citrus Swallowtail, *Papilio demodocus* Esper, 1798.

Family Erebidae (Underwings, litter moths)

Erebidae is one of the largest families of moths. Many common names are applied to the different groups of this family such as, the underwings, litter moths, tiger moths, tussock moths and owlets. Larvae feed on grasses, shrubs, or trees. Two species have been recorded from Kuwait: *Utetheisa pulchella* (Linnaeus, 1758) (Figure 83 H) and *Plutella xylostella* (Linnaeus, 1758).

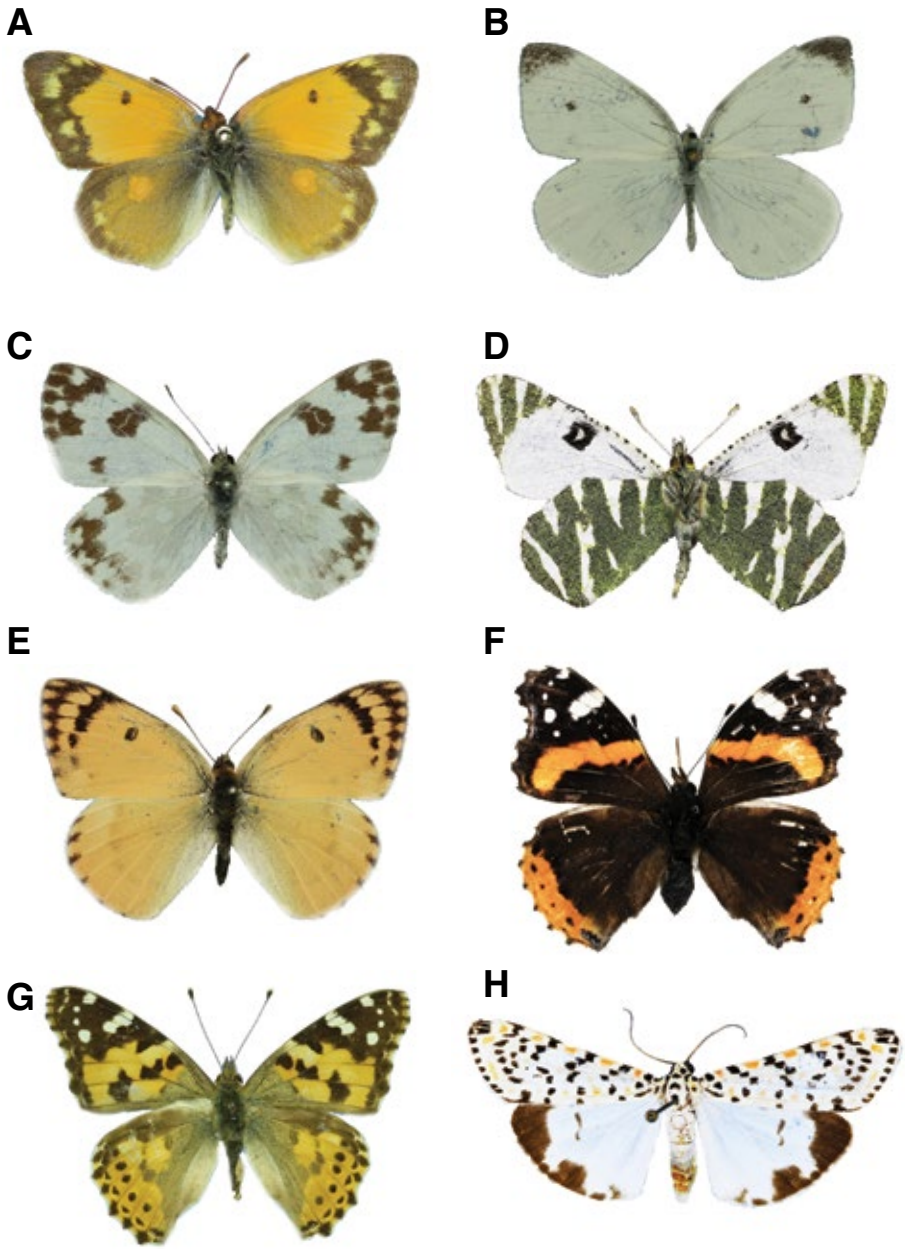

Figure 83: *A. Danaus chrysippus* (Linnaeus, 1758) B. *Artogeia rapae* Schawerda, 1905 C and D. *Euchloe belemia* (Esper, 1799), dorsal and ventral views E. *Madais fausta* (Oliver, 1804) F. *Vanessa atalanta* (Linnaeus, 1758) G. *Vanessa cardui* Linnaeus, 1758 H. *Utetheisa pulchella* (Linnaeus, 1758) (Photos by A. Katbeh-Bader).

Family Geometridae (Measuringworms, loopers)

Geometridae are mostly small, delicate, and slender moths. Its wings are usually broad and often marked with fine, wavy lines. The two sexes are often different in colour, and in a few species, the females are wingless or have only rudimentary wings. Seven species have been recorded from Kuwait (Table 28).

Table 28: Geometridae of Kuwait.

Cyclophora rufistrigata (Hampson, 1896)
Idaea macraria (Staudinger, 1892)
Lithostege notata Bang-Haas, 1907
Lithostege palaestinensis Wiltshire, 1941
Rhodometra sacraria (Linnaeus, 1767)
Tephrina disputaria (Guenee, 1858)
Eupithecia ultimaria Boisduval, 1840

Family Lasiocampidae (Eggars or snout moths)

Lasiocampidae are large moths. The eyes are small, antennae bipectinate in both sexes, the palpi are extended forward, proboscis absent. The larvae feed on the foliage of trees, often causing serious damage. Pupation occurs in a well-formed cocoon. Three species have been recorded from Kuwait: *Autosphyla henkei* Staudinger, 1879 *Chilena laristana* Daniel, 1949 and *Streblote siva* (Lefebvre, 1827).

Family Noctuidae (Owlet moths, noctuid moths)

Noctuidae have filiform antennae, mottled brown front wings, hind wings differ from front wings in colour and/or pattern. Unbranched subcosta (Sc) arises near base of hind wing. Three medio-cubital veins reach distal margin of hind wing. Most species feed on foliage, but some bore into fruits and considered serious plant pests. A total of 43 species have been recorded from Kuwait (Table 29). Twelve species are shown in Figures 84 and 85.

Family Pyralidae (Pyralid moths, snout moths or grass moths)

Pyralidae are small to medium and occasionally large moths (wingspan 0.9-3.7 cm) with variable morphological features. Adults hold their wings out to the side, fold them flat, or roll them up, making their bodies look like sticks. Larvae feed on dried vegetable matter, cereals, flour, stored grains, and beeswax. Only one species has been recorded from Kuwait, *Ephestia kuehniella* Zeller, 1879.

Family Sphingidae (Hawk moths, sphinx moths, and hornworms)

Sphingidae are characterized by having the antennae thickest near mid-point, sometimes bipectinate. Long, narrow forewings with a posterior angle greater than 120. Hind wings much shorter than forewings. The body is somewhat spindle shaped, tapering, and pointed both anteriorly and posteriorly. Larvae feed on a wide range of wild and cultivated plants. Six have been recorded from Kuwait (Table 30). Four speies are shown in Figure (85) and *Macroglossum stellatarum* (Linnaeus, 1758) in Figure (86).

Table 29: Noctuidae of Kuwait.

Acontia biskrensis orientalis Brandt, 1939
Acontia lucida (Hufnagel, 1766)
Agrotis biconica Kollar, 1844
Agrotis exclamationis Linnaeus, 1758
Agrotis ipsilon (Hufnagel, 1766)
Agrotis hoggari Rothschild, 1920
Agrotis sardzeana Brandt, 1941
Agrotis segetum (Denis & Schiffermuller, 1775)
Agrotis spinifera (Hübner, 1808)
Anua tirhaca (Cramer, 1777)
Anumeta arabiae Wiltshire, 1961
Armada maritima Brandt, 1939
Armada panaceorum (Menetries, 1849)
Autographa gamma (Linnaeus, 1758)
Autophila cerealis Draudt, 1936
Calphasia kraussi (Rebel, 1895)
Ceracala sana Staudinger & Rebel, 1901
Cleonymia chabordis Oberthur, 1876
Chrysodeixis acuta (Walker, 1858)
Clytie benenotata (Warren, 1888)

Chazaia incarnata (Freyer, 1838)
Chlorissa discessa Walker, 1861
Cornutiplusia circumflexa (Linnaeus, 1767)
Ctenoplusia limbirena (Guenée, 1852)
Earias insulana Boisduval, 1833
Euxoa excellens Grote, 1875
Grammodes boisdeffrii (Oberthür, 1867)
Helicoverpa armigera (Hubner, 1827)
Helicoverpa zea (Boddie, 1850)
Heliothis nubigera Herrich-Schaffer, 1851
Heliothis peltigera (Denis & Schiffermuller, 1775)
Leucania loreyi (Duponchel, 1827)
Metopoceras delicata (Staudinger, 1897)
Metopoceras omar (Oberthur, 1887)
Ozarba algaini Wiltshire, 1983
Paradrina clavipalpis (Scopoli, 1763)
Peridroma saucia (Hübner, 1808)
Rhabinopteryx subtilis (Mabille, 1888)
Spodoptera cilium Guenee, 1852
Spodoptera exigua (Hugner, 1808)
Spodoptera littoralis (Boisduval, 1833)
Spodoptera litura (Fabricius, 1775)
Thiacidas postica Walker, 1855
Thria robusta Walker, 1857
Trichoplusia daubei (Boisduval, 1840)
Trichoplusia ni (Hubner, 1802)

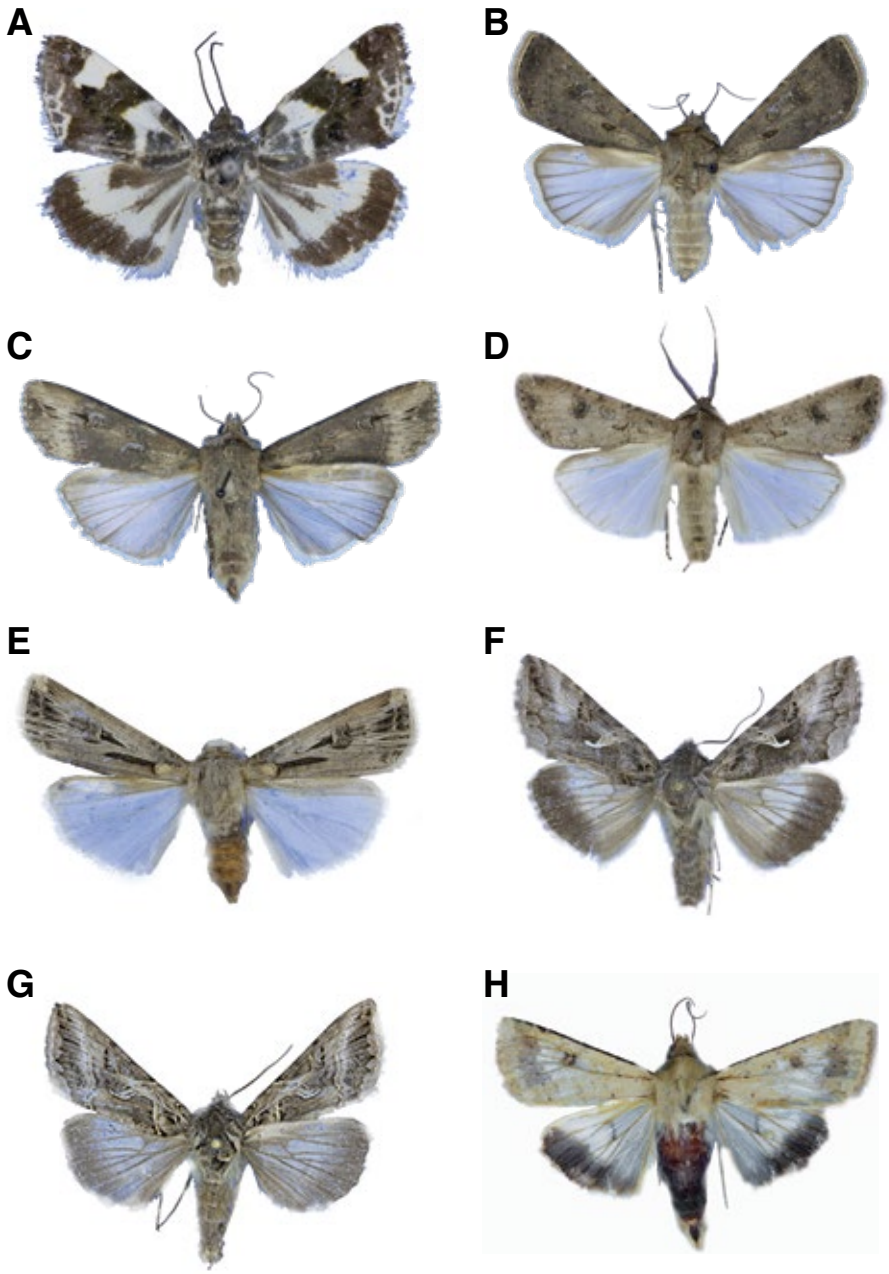

Figure 84: A. *Acontia lucida* (Hufnagel, 1766) B. *Agrotis exclamationis* Linnaeus, 1758 C. *Agrotis ipsilon* (Hufnagel, 1766) D. *Agrotis segetum* (Denis & Schiffermuller), 1775 E. *Agrotis spinifera* (Hübner, 1808) F. *Autographa gamma* (Linnaeus, 1758) G. *Cornutiplusia circumflexa* (Linnaeus, 1767) H. *Helicoverpa armigera* (Hubner, 1827) (Photos by A. Katbeh-Bader).

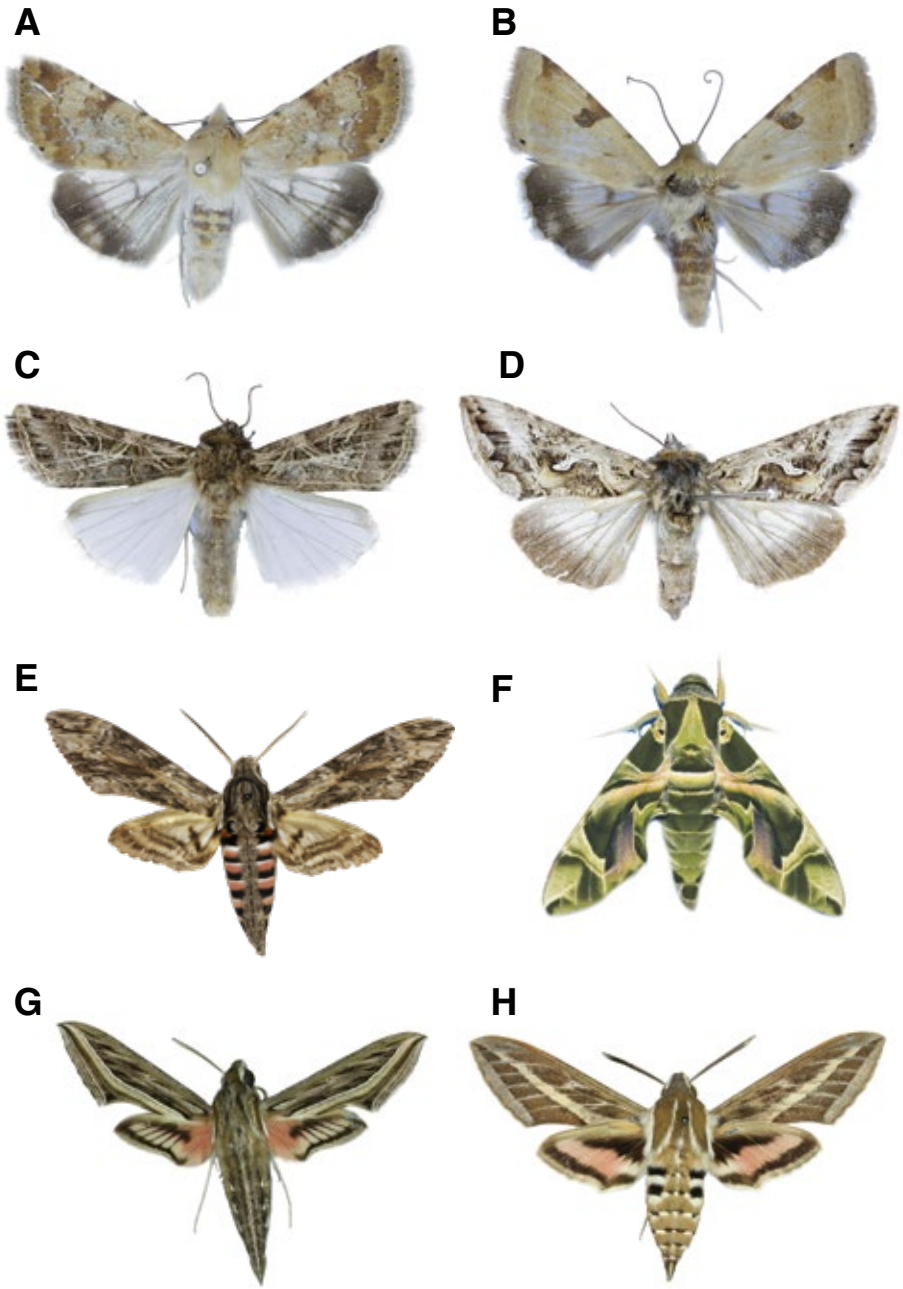

Figure 85: A. *Helicoverpa armigera* (Hubner, 1827) B. *Heliothis peltigera* (Denis & Schiffermuller, 1775) C. *Spodoptera littoralis* (Boisduval, 1833) D. *Trichoplusia ni* (Hubner, 1802) E. *Agrius convolvuli* (Linnaeus, 1758) F. *Daphnis nerii* (Linnaeus, 1758) G. *Hippotion celerio* (Linnaeus, 1758) H. *Hyles lineata livornica* (Esper, 1780) (Photos by A. Katbeh-Bader).

Figure 86: *Macroglossum stellatarum* (Linnaeus, 1758) (Photo by A. Katbeh-Bader).

Table 30: Sphingidae of Kuwait.

Acherontia atropos (Linnaeus, 1758)
Agrius convolvuli (Linnaeus, 1758)
Daphnis nerii (Linnaeus, 1758)
Hippotion celerio (Linnaeus, 1758)
Hyles lineata livornica (Esper, 1780)
Macroglossum stellatarum (Linnaeus, 1758)

Family Tineidae (Tineids)

Tineidae are small moths with reduced wing venation. The maxillary palps have five segments and are usually large and folded, and the labial palps are short. Most larvae are scavengers, fungivorous, while some feed on woolen fabrics causing economic damages. The carpet moth, *Trichophaga tapetzella* (Linnaeus, 1758) has been recorded from Kuwait.

Family Crambidae (Crambid snout moths, grass moths)

Crambidae are mostly small to large moths, similar to those in the Pyralidae family, usually whitish or pale yellowish brown. When at rest, holds its wings close to the body, hence the name ‘closewing’. Three species have been re-

corded from Kuwait: *Cornifrons ulceratalis* Lederer, 1858 *Nomophila noctuella* (Denis & Schiffermüller, 1775) and *Chrysoteuchia culmella* (Linnaeus, 1758).

Family Gelechiidae (Twirler moths or gelechiid moths)

Gelechiidae is one of the largest of the microlepidoptera. They are all rather small. The hind wing usually has the outer margins somewhat pointed and recurved.

Gelechiid larvae vary in habits. Some are leaf miners, galls makers, leaf rollers. One species is a pest of stored grain. The pink bollworm, *Pectinophora gossypiella* (Saunders, 1844), has been recorded from Kuwait.

3.18 Order Diptera

Order Diptera is one of the largest holometabolous insect orders. Its members can be distinguished by having only one pair of functional wings (the forewings) while the hind pair is reduced to small, knobbed structures called halteres that help it fly in equilibrium during flight. The mouthparts of Diptera are either piercing sucking mouthparts as in mosquitoes, or sponging or lapping as in houseflies, but some flies have nonfunctional mouthparts and do not feed. Many dipterans are of economic importance attacking cultivated plants such as fruit flies, apple maggots, and leaf miners.

Mosquitoes, horse flies, black flies, stable flies, and others are bloodsucking feeding on humans or animals. They transmit the causal agents of serious diseases like malaria, typhoid, dysentery, filariasis, dengue, yellow fever, and others. Some flies are scavengers, such as house flies and blow flies, and can be important disease vectors. However, many flies are considered beneficial as scavengers, predators or parasitoids of insect pests, or pollinators of cultivated plants.

Some Diptera larvae are aquatic and can be abundant in streams, lakes, ponds, puddles, swaps, and brackish water. Some larvae are terrestrial and feed on plants as leaf miners, gall makers, stem or root borers. Predaceous larvae may be aquatic or terrestrial living in soil, under stones or on vegetation. Many larvae feed on decaying plant or animal matter.

The most important characteristics used in identifying flies are the wing venation, antennae shape and number of antennal segments, distribution of hairs on the head and thorax (chaetotaxy), and the pulvilli and empodium on the legs.

Family Agromyzidae (Leaf miner flies)

Agromyzidae are small usually blackish or yellowish flies. Their larvae are leaf miners, but adults occur almost everywhere. Many species can be identified by the pattern of leaf mines which they make on the leaves rather than by

the insects themselves. One species, *Chromatomiya horticola* Goureau 1851, has been recorded from Kuwait.

Family Anthomyiidae (Flower flies)

The Anthomyiidae have the second antennal segment which reaches wing margin and the hypopleura is without bristles. They are common flies, like the house fly. Larvae habits vary, many are serious pests of cultivated plants, many are scavengers, living in excrement or decaying materials, some are aquatic. Only one species has been recorded from Kuwait, *Anthomyia tempestatum* Wiedemann 1818.

Family Asilidae (Robber flies and grass flies)

Asilidae are characterized by hollowed top of the head between eyes, often hairy body, and some resemblance to bumble bees. Adult males and females attack other insects even those that are larger than their own size including bees, wasps, beetles, dragonflies, grasshoppers, and other flies. They are usually found in open and sunny habitats during the hottest part of the day. Larger robber flies bite if carelessly handled. Larvae are predaceous on other insect larvae. The robber flies of Kuwait consist of six species (Al-Houty, 1997) (Table 31). *Apoclea femoralis* (Wiedemann, 1828) is shown in Figure (87).

Figure 87: *Apoclea femoralis* (Wiedemann, 1828) (Photo by A. Katbeh-Bader).

Table 31: Asilidae of Kuwait.

Apoclea algira (Linnaeus, 1767)
Apoclea femoralis (Wiedemann, 1828)
Dasypogon jugulum (Loew, 1847)
Habropogon appendiculatus Schiner, 1867
Laphystia erberi Schiner, 1865
Machimus cingulatus (Fabricius, 1781)

Family Bombyliidae (Bee flies)

Bee flies are stout bodied and hairy insects, usually found on flowers or resting on the ground in open areas. Some species have very long proboscis. Larvae are parasites of other insects or predaceous on grasshopper eggs. A total of 12 species of bee flies (Table 32) have been reported from Kuwait by Al-Houty (1997).

Table 32: Bombyliidae of Kuwait.

Anastoechus exalbidus (Wiedemann, 1820)
Anastoechus miscens Walker, 1871
Anastoechus niveus Hermann, 1909
Anastoechus trisignatus Portschinskii, 1881
Bombylius medius (Linnaeus, 1758)
Bombylius megacephalus Portschinskii, 1887
Cytherea nucleorum (Becker, 1902)
Heteralonia mucorea (Klug, 1832)
Parachistus pulchellus Greathead, 1980
Spogostylum ocyale (Wiedemann, 1828)
Usia aurata (Fabricius, 1794)
Villa bivirgata Austen, 1937

Family Calliphoridae (Blow flies)

The Calliphoridae are about the size of a house fly or larger. Many species are metallic blue or green. The arista of the antennae is plumose at the tip. Most species are scavengers. The larvae feed on carrion, excrement, and similar organic materials. Some species may cause myasis in humans. Seven species are known to occur in Kuwait (Table 33). *Chrysomya albiceps* Wiedemann, 1819 and *Lucilia sericata* (Meigen, 1826) are shown in Figure (88).

Table 33: Calliphoridae of Kuwait.

Calliphora erythocephala Meigen, 1826
Calliphora vicina Robineau-Desvoidy, 1830
Chrysomya albiceps Wiedemann, 1819
Chrysomya marginalis (Wiedemann, 1830)
Chrysomya megacephala (Fabricius, 1794)
Lucilia cuprina (Wiedemann, 1830)
Lucilia sericata (Meigen, 1826)

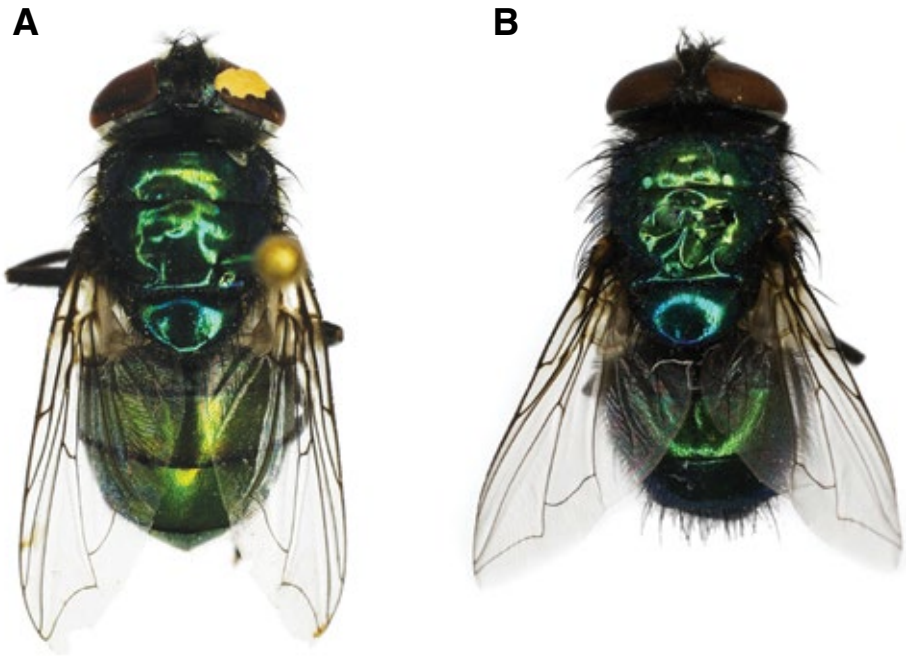

Figure 88: A. *Chrysomya albiceps* Wiedemann, 1819 B. *Lucilia sericata* (Meigen, 1826) (Photos by A. Katbeh-Bader).

Family Chironomidae (Chironomids, non-biting midges, or lake flies)

Chironomidae are very common insects found almost everywhere. They superficially resemble mosquitoes, but they have no scales on their wings, and do not have any piercing sucking mouth parts. The front legs are usually the longest, and the metanotum has a keel or furrow. The males usually have plumose antennae. Neither male nor female bite. Larvae are common aquatic or semi-aquatic found in large numbers in streams, lakes, ponds, treeholes,

artificial containers, rotting vegetation, soil, and in sewage. Eight speies have been recorded from Kuwait (Table 34).

Table 34: Chironomidae reported from Kuwait.

Chironomus attenuates Walker, 1848
Chironomus calipterus Kieffer, 1908
Chironomus pulcher Wiedemann, 1930
Limnophyes natalensis (Kieffer, 1914)
Polypedilum (*Polypedilum*) *nubifer* (Skuse, 1889)
Polypedilum nubeculosum (Meigen, 1804)
Procladius brevipetiolatus (Goetghebuer, 1935)
Chironomus dorsalis Meigen, 1818

Family Chloropidae (Grass flies)

The Chloropidae are small bare flies, and some are bright yellow and black. They are common in grassy areas. Certain larvae feed in grass stems and may become serious pests of cereals. A few species are scavengers, while a small number are parasitic or predaceous. The following three species were previously recorded from Kuwait: *Aphanotrigonum subfasciella* Collin, 1949 *Metopostigma tenuiseta* (Loew, 1860) and *Ophiomyia beckeri* Hendel 1923.

Family Coelopidae (Seaweed flies)

The Coelopidae are medium sized to small flies, usually dark brown or black, and have the dorsum of the thorax conspicuously flattened and the body and legs are very bristly. These flies live along the seashore and are particularly abundant where various seaweeds have washed up. *Microprosopa hoberlandti* Sifner, 1981 was recorded from Kuwait.

Family Culicidae (Mosquitoes)

Adult mosquitoes can be distinguished by the wing venation, presence of scales on the wing veins, and the piercing sucking mouthparts. Female adults feed on blood of humans and animals and transmit important causal agents of diseases such as malaria, yellow fever, dengue, encephalitis, filariasis, and West Nile fever. Adult males do not bite and feed on nectar or plant juices.

The larvae (wrigglers) and pupae are aquatic and can be found in ponds, pools, artificial containers or in tree holes and other stagnant water bodies. The larvae feed mainly on algae or organic debris, but some species prey upon other mosquito larvae. Eggs are laid singly, near or on water, or as egg rafts on water surface.

Mosquitoes of Kuwait were studied by Salit et al. (1994 & 1996). Recently, two additional species were added to the list of the mosquitoes of Kuwait (Reeves et al., 2016; Colton et al., 2019). There are 13 species belonging to four genera (Table 35).

Family Drosophilidae (Pomace flies or small fruit flies)

The Drosophilidae are common flies that breed in decaying fruits or fungi. The larvae feed on the yeasts growing in the fruits. A few species are ectoparasitic on caterpillars or predaceous on mealybugs and other small Hemiptera in the larval stage. Two species have been recorded from Kuwait: *Drosophila melanogaster* (Meigen, 1830) and *Zaprionus idiana* Gupta, 1970.

Family Ephydridae (Shore flies)

The Ephydridae are small to very small, dark-coloured, however, a few have pictured wings. Adults are found in marshes and shorelines of ponds, streams, and the sea. The larvae are aquatic, and many species live in brackish, strongly saline, or alkaline water. The following two species were recorded from Kuwait: *Actocetor margaritatus* Wiedemann, 1830 and *Ephydra flavipes* (Macquart, 1843).

Table 35: Mosquitoes (Culicidae) recorded from Kuwait.

Subfamily	Species
Anophelinae	*Anopheles pulcherrimus* Theobald, 1902
	Anopheles pharoensis Theobald, 1901
	Anopheles *stephensi* Liston, 1901
Culicinae	Culex *pipiens molestus* Linnaeus, 1758
	Culex perexiguus Theobald, 1903
	Culex *pusillus* Macquart, 1850
	Culex *quinquefasciatus* Say, 1823
	Culex theileri Theobald, 1903
	Culex *tritaeniorhynchus* Giles, 1901
	Culex univittatus Theobald, 1901
	Culiseta annulata (Schrank, 1776)
	Culiseta longiareolata Macquart, 1838
	Aedes caspius (Pallas, 1771)

Family Fanniidae (Lesser house flies)

Fanniidae (lesser house flies) appear like small house flies. Most species differ from Muscidae in having 3A curved outward distally. Fanniidae is considered sometimes as a subfamily of Muscidae. The larvae breed in excrement and various types decaying organic matter. So far, only *Fannia canicularis* (Linnaeus, 1761) has been recorded from Kuwait.

Family Gasterophilidae (Horse bot flies)

Gasterophilidae (horse bot flies) are bee-like flies. Larvae develop in stomach or intestine of the horse, and when fully grown, they pass out with the faeces and pupate in the ground. Eggs are laid on lips or jaws of the horse. *Oestrus intestinalis* (De Geer, 1776) was recorded from Kuwait.

Family Hippoboscidae (Louse flies and bat flies)

The Hippoboscidae may be winged or wingless, usually found on birds or sheep. They are easily recognized by their flat shape and leathery appearance. *Hippobosca camelina* Leach, 1817 was recorded from Kuwait.

Family Muscidae (House flies)

Muscidae (house flies) have their anal vein short and not reaching the wing margin. The house flies *Musca domestica*, breeds in filth, and it is a vector for typhoid fever, dysentery, cholera, yaws, anthrax, some forms of conjunctivitis, and other diseases. Seven species have been recorded from Kuwait (Table 36). *Musca domestica* Linnaeus, 1758 is shown in Figure 89.

Table 36: Muscidae of Kuwait.

Antherigona iota Pont, 1981
Coenosia attenuata Steinin Becker, 1903
Limnophora tigrina (Amstein, 1860)
Lipse pygmaea Fallen, 1825
Musca domestica Linnaeus, 1758
Musca lucidula (Loew, 1856)
Muscina stabulans (Fallen, 1817)

Figure 89: *Musca domestica* Linnaeus, 1758 (Photo by A. Katbeh-Bader).

Family Oestridae (Bot and warble flies)

Oestridae are large hairy beelike, antennae small and sunken in the head, mouthparts reduced. Larvae are endoparasites of mammals, and some are important pests of livestock. Two species have been previously recorded from Kuwait. *Oestrus ovis* L. (the sheep bot fly) is viviparous and deposits its larvae in the nostrils of sheep or rarely in humans. The larvae feed in the frontal sinuses of sheep. *Cephalopina titillator* (Clark, 1816) and *Oestrus ovis* Linnaeus, 1758 were recorded from Kuwait.

Family Phoridae (Hump-backed flies)

Phoridae are small or minute flies easily recognized by their humpbacked appearance, the wing venation, the laterally flattened hind femora, and erratic

way they run. The adults are common in many habitats but most abundant around decaying vegetation. Some larvae live in decaying animal or vegetable matter, in fungi, or in other insects. *Megaselia scalaris* Loew, 1866 was recorded from Kuwait.

Family Piophilidae (Skipper flies or cheese flies)

Piophilidae are usually less than 5 mm long and are rather metallic black or bluish. Their larvae are scavengers, and some feed on cheese or preserved meat. The name 'skipper' refers to the jumping behavior of larvae. *Piophila casei* (Linnaeus, 1758) was recorded from Kuwait.

Family Pipunculidae (Big-headed flies)

The Pipunculidae are small flies with a very large head composed mostly of its eyes. The wings are somewhat narrowed basally, and the anal cell is usually long and closed near the wing margin. The larvae are parasites of leafhoppers and planthoppers. *Tomosvaryella subvirescens* (Loew, 1872) was recorded from Kuwait.

Family Psychodidae (Moth and sand flies)

The Psychodidae are called moth flies (subfamily Psychodinae) or sand flies (subfamily Phlebotominae). Adults are small hairy mothlike flies. They live in moist, shady places near sewers or drains. Larvae live in water, mud, decaying vegetable matter, or in mosses. Sand flies are bloodsucking acting as vectors of diseases such as pappataei fever (caused by a virus), in the Mediterranean region and kala-azar and oriental sore (caused by leishmania). Most moth flies are harmless, but few rare cases of human myiasis have been reported.

Six species of sand flies have been reported from Kuwait (Hussien & Behbehan, 1976; Lane & Al-Taqi, 1983) (Table 37). Leishmaniasis is known from Jahra district in Kuwait, whereas the disease is caused by *L. major*.

Table 37: Psychodidae (sand flies) reported from Kuwait.

Phlebotomus papatasi (Scopoli, 1786)
Phlebotomus alexandri Sinton, 1928
Sergentomyia antennata (Newstead, 1912)
Sergentomyia squamipleuris (Newstead, 1912)
Sergentomyia clydei (Sinton, 1928)
Tinearia alternata (Say, 1824)

Family Sarcophagidae (Flesh flies)

Sarcophagidae are similar to Calliphoridae (blow flies). Most species are blackish with gray thoracic stripes, but not metallic. Adults feed on nectar, fruit juices, sap, and honeydew. Larvae feed on carrion, some are parasites of beetles or grasshoppers. Some species, cause skin pustules on vertebrates, and may infest humans. Four species have been recorded from Kuwait: *Sarcophaga carnaria* (Linnaeus, 1758), *Sarcophaga haemorrhoidalis* (Fallen, 1817), *Parasarcophaga ruficornis* (Fabricius, 1794) and *Wohlfahrtia nuba* (Wiedemann, 1830).

Family Scatopsidae (Minute black scavenger flies)

The Scatopsidae are black or brownish, usually 3 mm long or less, and have short antennae. The veins near the costal margin of the wing are heavy while the remaining veins are weak. The larvae breed in decaying material and excrement. *Coboldia fuscipe* (Meigen, 1830) was recorded from Kuwait.

Family Syrphidae (Hover flies or flower flies)

The Syrphidae can be recognized by the presence of the spurious vein on the wings between the radius and the media. Adults often resemble bees and wasps. Larvae are scavengers or predaceous on other insect such as aphids. Twelve species have been previously recorded from Kuwait (Table 38). *Eristalinus aeneus* (Scopoli, 1763) *Eristalinus megacephalus* (Rossi, 1794) *Syrphus corollae* Fabricius, 1794 are shown in Figure 90.

Table 38: Syrphidae of Kuwait.

Conops aneus (Scopoli, 1763)
Episyrphus balteatus (De Geer, 1776)
Eristalinus taeniops (Wiedemann, 1819)
Eristalinus aeneus (Scopoli, 1763)
Eristalinus megacephalus (Rossi, 1794)
Eristalis tabanoides (Jaennicke, 1867)
Eumerus turkmenorum Paramanov, 1927
Ischiodon aegypticus (Wiedemann, 1830)
Eupeodes (Metasyrphus) luniger (Meigen, 1822)
Syrphus corollae (Fabricius, 1794)
Sphaerophoria turkmenica Bankowska, 1964

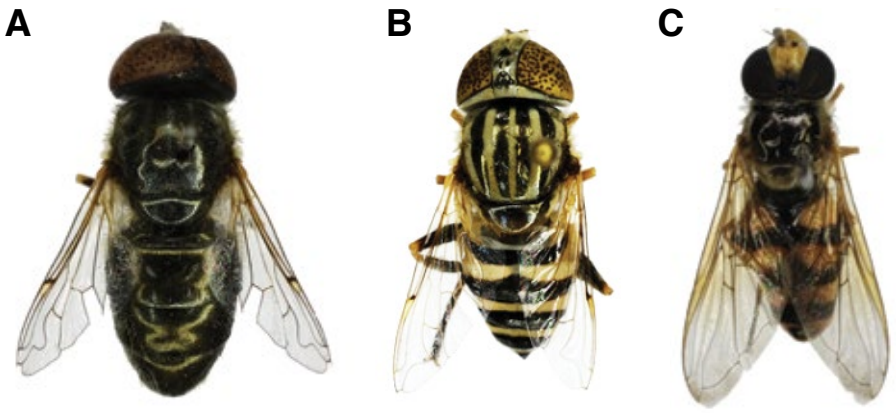

Figure 90: A. *Eristalinus aeneus* (Scopoli, 1763) B. *Eristalinus megacephalus* (Rossi, 1794) C. *Syrphus corollae* Fabricius, 1794 (Photos by A. Katbeh-Bader).

Family Tabanidae (Horse flies and deer flies)

Tabanidae are stout-bodied, medium-sized flies with 3rd antennal segment elongate (stylate). The head is hemispherical. Most adult females feed on blood of warm-blooded animals, but some species attack cold-blooded vertebrates. Several subfamilies are not hematophagous. Some species are annoyance pests and loss of blood is suffered by domestic and wild animals and man. Some species are vectors for rickettsia, protozoa, and filarial worms. Larvae are predaceous and mainly inhabit wetland soil, margins of streams and ponds, and some species are found in saline marches. Two species are known from Kuwait, *Tabanus taeniola* Polisot De Beavois 1807 (Figure 91), 1807 (Figure 92) and *Tabanus arabicus* Macquart, 1839.

Family Tachinidae (Parasite flies)

The Tachinidae can be recognized by the developed hypopleural, pteropleural bristles, and post- scutellum. Many tachinids are very similar in general appearance to muscids and flesh flies. Larvae are parasites of other insects such as the Lepidoptera and Orthoptera and many help in keeping pest species in check. *Drino latigena* Mesnil, 1944 was recorded from Kuwait.

Family Tephritidae (Fruit flies)

The Tephritidae usually have spotted or banded wings. Adults are found on flowers or vegetation. Larvae are plant feeders. Some species are serious pests of fruits such as the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann, 1824). Seven species are known from Kuwait (Table 39).

Figure 91: *Tabanus taeniola* (Polisot De Beavois, 1807) (Photo by A. Katbeh-Bader).

Table 39: Tephritidae of Kuwait.

Acanthiophilus helianthi (Rossi, 1794)
Bactrocera oleae (Rossi, 1790)
Trupanea stellata (Fuessli, 1775)
Ceratitis capitata (Wiedemann, 1824)
Trypeta amoena Frauenfeld, 1857
Trypeta augur Frauenfeld, 1857
Trupanea stellata (Fuesslin, 1775)

Family Therevidae (Stiletto flies)

The Therevidae resemble rubber flies (predators) but feed on nectars. Adults common in sunny patches. Larvae occur in soil or decaying materials and are predaceous, often important in controlling larval Coleoptera and may be potential biological control agents. *Hoplosathe frauenfeldi* (Loew, 1856) (Figure 92) was recorded from Kuwait.

Figure 92: *Hoplosathe frauenfeldi* (Loew, 1856) (Photo by A. Katbeh-Bader).

Family Ulidiidae (Picture-winged flies)

Ulidiidae are small to medium-sized flies. Their wings are marked with black, brown, or yellow, and their body is often shining and metallic. They are typically found in moist places and are often very abundant. Some of their larvae feed on plants and may become agricultural pests, but some larvae live in decaying materials. *Melieria omissa* (Meigen, 1826) (Figure 93) and *Physiphora olceae* Preyssler, 1791 were recorded from Kuwait.

Figure 93: *Melieria omissa* (Meigen, 1826) (Photo by A. Katbeh-Bader).

3.19 Order Siphonaptera (Fleas)

Fleas are laterally flattened, bristly, wingless insects with sucking mouthparts. The bristles are often present on head or thorax (the genal and the pronotal combs). Hind femura enlarged, adapted for jumping. Larvae are slender whitish, legless, with well developed head, found in dirt or debris or in nest of host. Adults are ectoparasites commonly associated with mammals or birds worldwide. They are most diverse in temperate zones. Fleas may be just an-

noying pest or can act as disease vectors (bubonic plague), endemic typhus (Rickettsia) and tape worms.

Al-Taqi and Al-Ziady (1982) studied fleas associated with rodents in Kuwait. Zaghloul et al. (1985) reported on fleas parasitizing the Indian Gerbil, *Tatera indica*. Eight species have been recorded parasitizing different species of rodents.

Family Pulicidae (Common fleas)

Common fleas of the family Pulicidae attack man and domestic animals such as cats and dogs. Eight species have been recordrd from Kuwait (Table 40). Of these are the cat flea (*Ctenocephalides felis*), the dog flea (*C. canis*), the human flea (*Pulex irritans*), and the oriental rat flea (*Xenopsylla cheopis*).

Table 40: Pulicidae (fleas) of Kuwait.

Ctenocephalides canis (Curtis, 1826)
Ctenocephalides felis (Bouché, 1835)
Pulex irritans Linnaeus, 1758
Synosternus pallidus (Taschenberg, 1880)
Xenopsylla astia Rothschild, 1911
Xenopsylla cheopis (Rothschild, 1903)
Xenopsylla conformis (Wagner, 1903)
Xenopsylla nubica (Rothschild, 1903)

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Appendix

Liquid agents

Distilled water should be used in these formulas. *Parts* is by volume.

AGA (Alcohol-Glycerin-Acetic Acid) solution

- Parts
- Commercial ethanol (ethyl alcohol) ..... 8 parts (Vol.)
- Water ..... 5 parts (Vol.)
- Glycerin ..... 1 parts (Vol.)
- Glacial acetic acid..... 1 parts (Vol.)

Barber's fluid

- Commercial ethanol (ethyl alcohol)..... 50 ml
- Water..... 50 ml
- Ethyl acetate (acetic ether)..... 20 ml
- Benzene (benzol)..... 7 ml

Hoyer's medium

- Chloral hydrate..... 200 g
- Water..... 50 g
- Gum Arabic (granules)..... 30 ml
- Glycerin..... 2 g

Dissolve gum Arabic in water at room temperature. Add chloral hydrate and allow to stand for a day or two until all solids have dissolved completely. Add glycerin. Filter through glass wool. Store in glass-stoppered bottle.

Essig's aphid fluid

- Lactic acid..... 20 parts (Vol.)
- Glacial acetic acid..... 4 parts (Vol.)
- Phenol (saturated H_2O solution)..... 2 parts (Vol.)
- Distilled water..... 1 part (Vol.)

KAAD (Kerosene-Acetic Acid-Dioxane) solution

- Commercial ethanol (ethyl alcohol).....10 parts (Vol.)
- Glacial acetic acid..... 2 parts (Vol.)
- Kerosene..... 1 part (Vol.)
- Dioxane..... 1 part (Vol.)

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