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Comprehensive Survey and Analysis of Cockroach Species in The Kurdistan-Region of Iraq

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Abstract

Cockroaches are the most prevalent urban pest in tropical regions. They are capable of transmitting disease and health problems to humans by contaminating foods, and by carrying microbes and allergens, acting as vectors for various pathogens of diseases. In the present study, 841 cockroach specimens were collected from 22 different areas in four provinces in the Kurdistan Region-Iraq from the beginning of May 2021 to mid-July 2023. The study areas include ten locations in Duhok province, four in Erbil province, five in Sulaymaniyah province, and three in Halabja province. During the study, five different species of cockroaches were collected and identified in the selected areas. These were *Periplaneta americana*, *Shelfordella lateralis*, *Blattella germanica*, *Polyphaga saussurei*, and *Supella longipalpa*. The number of specimens collected from each province is as follows: Duhok: 430 specimens; Erbil: 161 specimens; Sulaymaniyah: 188 specimens; and Halabja: 62 specimens. Our data show that species distribution changed in each province throughout the study. Duhok had *P. americana*, *S. lateralis*, and *B. germanica*; Erbil had *P. americana*, *S. lateralis*, *B. germanica*, and *P. saussurei*; Sulaymaniyah had *P. americana*, *S. lateralis*, *P. saussurei*, and *S. longipalpa*; and Halabja had *P. americana*, *S. lateralis*, and *P. saussurei*. *P. americana* was the most common cockroach species, accounting for 377 (44.82%) of the specimens. Following were *S. lateralis* 282 (33.53%), *B. germanica* 147 (17.47%), *S. longipalpa* 24 (2.85%), and *P. saussurei* 11 (1.30%).

Key words: Cockroaches, Survey, Blattodea, *Periplaneta americana*, *Shelfordella lateralis* and Distribution.

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Introduction

Cockroaches are the most ancient inhabitants of the planet (Fazeli-Dinan et al., 2022). These insects have been around for 300 million years, with over 4600 species now recognized (Guzman & Vilcinskis, 2020). They are hemimetabolous insects (Zhang et al., 2013) of the Class Insecta, belonging to the Order Blattodea (Dimitriadou et al., 2021). They are classified into five families: Cryptocercidae, Blattellidae, Blaberidae, Blattidae, and Corydiidae. Most of them are distributed

in tropical and subtropical areas of the world (Albalawi et al., 2023), but only a few occur in temperate regions (Nuwer, 2013). They can adapt to a wide range of environments, making them cosmopolitan insects that can thrive in both arctic and tropical climates (Adedara et al., 2022). They residing near human territory in building cracks, tree bark, beneath rotting leaves, debris, and floating debris on river banks (Gondhalekar et al., 2021). All cockroaches are yellowish-brown in color, have a flattened appearance (Ifeanyi & Olawumi, 2015), with a dual wing structure (Keiding, 1986). These arthropods have nocturnal activity and are omnivorous species (Salehzadeh et al., 2017). In addition, their adult can survive without food for several weeks and reproduce year-round under favorable environmental conditions. These characteristics of cockroaches likely contribute to their prevalence (Maji & Ahmed, 2023). *B. germanica* (German cockroach), *P. americana* (American cockroach), and *Blattella orientalis* (Oriental cockroach) are the most prevalent pests in humans (Hamu et al., 2014). The *P. americana* is the largest of all species, measuring 30mm length while, the German cockroach measures only 15mm (Kassiri et al., 2018). Because of their biology, unclean habits, eating habits, and morphology, they can pick up pathogens and transmit them mechanically (Adenusi et al., 2018). Moreover, they act as vectors of bacteria, fungi, viruses, protozoa, and Helminths (Tilahun et al., 2012). They also have an essential role in transmitting foodborne diseases by contaminating food with their droppings (Moges et al., 2016). On the other hand, contact with the cockroaches' bodies may cause infections by enteric diseases in humans (Maji & Ahmed, 2023). This is the first study in this region focusing on the species of cockroaches, their morphological features, and their distribution in the Kurdistan Region- Iraq. This research aimed to examine the present distribution patterns of several cockroach species. Additionally, attempted to provide a foundation of knowledge on the primary cockroach species and their predominance in the Kurdistan Region-Iraq. The provided information has significant value in the development of control measures.

Materials and Methods

Study Area

The survey was conducted in different localities (i.e., apartments, units, streets, stores, barns, parks, or housings) in 22 districts, sub-districts, and province centers in the four Kurdistan/Iraq provinces. At least three areas in each province were randomly sampled for cockroaches. Duhok center, Zawita sub-district, Baqera, Kora, and Khelake villages; Zakho; Amadyiah; Shekhan; Bardarash; and Kalak districts for Duhok province. Erbil center, Khabat, Soran, and Shaqlawa districts for Erbil Province. Sulaymaniyah center, Chamchamal, Rania, and Saidaadiq districts, Chwar Qurna sub-district, for Sulaymaniyah province. Halabja center, Serwan, and Khormal districts for Halabja province.

Cockroaches Sampling

A total of 841 cockroaches were collected by manual catching by hand using paper cups in the first hours of the night, and after being captured, they were placed by forceps separately in a 25-ml Makarthy Test Tube with Aluminum Cap (vials) (Chamavit et al. 2011) containing 96% ethanol. Cockroaches were collected during the months of May, June, July, and August of 2021, 2022, and 2023, respectively. The collected specimens were regularly examined under the dissecting microscope at the Department of Biology/College of Science/ University of Duhok using the standard and reliable taxonomic keys of Rehn (1951) and McKittrick (1964). Each vial is labeled with the following information about the collected specimens: province code, locality code, date of collection (including day, month, and year), and number of specimens.

Morphological identification

The study was based on male and female adults. All specimens were identified at the family, genera, and species levels using many different keys to identify the specimens (Rehn, 1951; McKittrick, 1964) and dissecting microscope. The Iraq Natural History Research Center and Museum, University of Baghdad, also identified the specimens. Male and female cockroaches of each species were examined and identified based on the shape of their abdomens and appendages. The female abdomen's end is boat-shaped, and its final segment is blunt. The abdomen's sternum is divided into two sub-segments, and it has only anal cerci. While the abdomen of male cockroaches is thin and the final segment is pointed, males have a pair of styli between their cerci.

Dissecting Lambomed type has been used for Cockroaches identification magnification ranges from about 2x-4x.

Measured morphological characters

The measured morphological characters included the head, thorax, and abdomen length and width. Cockroach body length was measured from head to the end of the abdomen, and width was the widest part of the tergum (Lin et al., 2022). The length and width of a character can be measured in mm units (Borah & Hazarika, 2019). The body parts were measured using a USB microscope camera with 2x magnification. The statistical analyses were performed with IBM SPSS Statistics software using one-way ANOVA. The values are shown as the mean \pm standard error, and range.

Results and Discussion

Identified species of cockroaches

From a total of 841 specimens collected from 22 different locations in the Kurdistan Region-Iraq, five species of cockroaches have been collected and identified during the entire sampling period: *P. americana*, *S. lateralis*, *P. saussurei*, *B. germanica*, and *S. longipalpa*. The recognized species have been classified into three families: the Blattidae, Blattellidae and Polyphagidae families. The classification of each collected cockroach is reported in Table 1.

(Table 1): Classification of the five cockroach species collected from the Kurdistan Region of Iraq

Order	Family	Genus	Species
Blattodea	Blattidae	<i>Periplaneta</i>	<i>P.americana</i>
		<i>Shelfordella</i>	<i>S. lateralis</i>
	Polyphagidae	<i>Polyphaga</i>	<i>P. saussurei</i>
	Blattellidae	<i>Blattella</i>	<i>B. germanica</i>
		<i>Supella</i>	<i>S. longipalpa</i>

This result agrees with the following findings: Hanafi Bojd and Sadaghiani (2001), found the following families: Polyphagidae, Blattidae, and Blattellidae in Iran. Furthermore, in Yasuj City, southwest Iran, Shahraki et al. (2013) found five species from two families: Blattidae and Blattellidae, which include *B. orientalis*, *B. lateralis*, *P. americana*; *B. germanica*; and *S. longipalpa*. Abul-Hab and Kassal (1987). Among the species identified in their research were *P. americana*, *B. germanica*, and *B. lateralis*; *S. supellectilium*; and *P. saussurei*, belonging to the following families: Blattellidae, Blattidae, and Polyphagidae in Baghdad province, central Iraq. Al-Fahdawi (1991) recognized 11 cockroach species in Ramadi City, central Iraq. On the other hand, according to Abdul-Jalil and Abdul-Zahra (1998), there are six species of cockroaches inhabited in Basra province, southern Iraq, including *P. americana*, *B. germanica*, *B. lateralis*, *S. longipalpa*, *B. mella*, and *P. aegyptica*. Hussni et al. (1976) confirmed that the most frequent species in Egypt are *P. americana* and *B. germanica* due to the suitable temperature and humidity for their reproduction. In 1980, Ozar documented the first observations of *S. longipalpa* and *B. germanica* in the Aegean Sea in Turkey, and *P. americana* and *B. orientalis*, which previously existed. Furthermore, as determined by Dimitriadou et al. (2021), the most common species in Greece are *B. orientalis* and *P. americana* (Blattidae), *B. germanica*, and *S. longipalpa* (Blattellidae).

Surveyed locations and number of specimens collected

The present study found a heterogeneous distribution of cockroaches that varied from one location to another (Table 2). This variation is attributable to several factors: the temperature of the sampling site, regular sanitary treatment against insects, the presence of a sanitation system, and the quantity of waste in the area. This distribution may depend on the feeding habits of the

cockroaches. Relatively similar results were obtained by Ziane et al. (2022). Gordon (1996) indicates that the wide difference in cockroach abundance among the species may be due to the species' different reproductive abilities. During the study period, it was observed that there was an increase in the number of cockroaches in areas with a significant human population. A study by Rivault and Cloarec (1996), suggested a correlation between cockroach population density and human population density. The current study shows a positive correlation between temperature and abundance of cockroaches during the months of May, June, July, and August compared to other months of the year. Memona et al. (2016) confirm that summer is the most suitable time for nymphs into adults. This result is in agreement with those of Appel et al. (1983); Slabber et al. (2007), and Manyullei et al. (2022). Fig. 1 shows where the specimens were collected during the study period.

(Table 2): Total number of cockroach specimens collected from four provinces in the Kurdistan Region-Iraq between 2021 and 2023

Provinces	#	Locations	X	Y
Duhok	255	Duhok center	43.036	36.846
	15	Zawita	43.167	36.906
	22	Bagera	43.175	36.965
	1	Kora	43.164	36.933
	44	Zakho	42.716	37.122
	29	Amediyah	43.468	37.101
	23	Bardarash	43.552	36.497
	11	Shekhan	43.379	36.689
	12	Khelake	43.6060	36.498
Erbil	18	Kalak	43.631	36.269
	41	Erbil center	44.028	36.185
	37	Khabat	43.668	36.260
	53	Shaqlawā	44.313	36.413
Sulaimaniyah	30	Soran	44.542	36.689
	61	Sulaymanyiah center	45.448	35.539
	32	Chamchamal	44.880	35.519
	46	Raniay	44.910	36.238
	15	Chwar qurna	44.831	36.209
Halabja	34	Said sadiq	45.859	35.356
	20	Halabja center	45.996	35.177
	19	Serwan	45.937	35.251
	23	Khormal	46.046	35.297

*X = longitude *Y = Latitude # = number of specimens



Fig. 1: Collection sites of cockroach specimens in Kurdistan Region, Iraq

Distribution of cockroach species for each province

Each collected cockroach species, and their numbers from various locations within each province have been documented and shown in Tables 3, 4, 5, and 6. A 430 specimens were collected from 10 different locations throughout the Duhok province, including three species: *P. americana*, *S. lateralis*, and *B. germanica*. Based on the provided data, it can be seen that *P. americana* presents the highest level of abundance within the Duhok province, followed by *B. germanica* and *S. lateralis* as shown in Table 3.

(Table 3): The specimens collected from the Duhok province

Regions		Duho kcent er	Zawit a	Bager a	Kor a	Zakho	Amediay h	Bardarash	Shekhan	khelak e	Kala k	overall
Species	sex											
<i>P.americana</i>	M	48				22		3	5	1	4	151
	F	40				19			6		3	
<i>S.lateralis</i>	M	16	7	14		1	11	3		2	8	137
	F	9	8	8	1	2	18	17		9	3	
<i>B.germanica</i>	M	41										142
	F	101										

*M=Male *F=Female

A 161 specimens were collected from four distinct localities in the province of Erbil. These specimens included four species, respectively *P. americana*, *S. lateralis*, *B. germanica*, and *P. saussurei*. According to the data shown in Table 4, the cockroach species most often found in Erbil province is *S. lateralis* followed by *P. americana* Table 4.

(Table 4): The specimens collected from Erbil province

Regions		Erbil center	Khabat	Shaqława	Soran	Overall
Species	sex					
<i>P.americana</i>	M	17	17			68
	F	15	17	1	1	
<i>S.lateralis</i>	M		2	31	3	84
	F		1	21	26	
<i>B.germanica</i>	M	3				5
	F	2				
<i>P.saussurei</i>	M	3				4
	F	1				

*M=Male *F=Female

P. americana, *S. lateralis*, *S. longipalpa*, and *P. saussurei* were among the 188 specimens collected from various locations within the province of Sulaymaniyah. During the survey period, *P. americana* had the highest population, while *S. lateralis*, *P. saussurei*, and *S. longipalpa* had the lowest.

(Table 5): The specimens collected from Sulaymaniyah province

Regions		Sulaimaniyah center	Chamchamal	Ranyia	Chawr qurna	Said sadiq	Overall
Species	sex						
<i>P.americana</i>	M	14	7	28	4	25	125
	F	11	7	18	2	9	
<i>S.lateralis</i>	M	7	14		2		38

	F	4	4	7	
<i>P. saussurei</i>	M	1			1
	F				
<i>S.longipalpa</i>	M	13			24
	F	11			

*M=Male *F=Female

Depending on the provided data, three species, including *P. americana*, *S. lateralis*, and *P. saussurei*, were collected from various places within the province of Halabja. In the population of cockroach species obtained from Halabja Province, it appears that *P. americana* shows the highest abundance, followed by *S. lateralis* and *P. saussurei*.

(Table 6): The specimens collected from Halabja province

Regions		Halabja center	Serwan	Khormal	overall
Species	sex				
<i>P. americana</i>	M	7	11	4	33
	F	6	5		
<i>S. lateralis</i>	M	4	1	10	23
	F			8	
<i>P. saussurei</i>	M	3	1		6
	F		1	1	

*M=Male *F=Female

Distribution and abundance of cockroach species

According to the findings of the current study, *P. americana* accounted for about 337 specimens (44.82%) of the cockroach species examined, with *S. lateralis* 282 (33.53%), *B. germanica* 147 (17.47%), *S. longipalpa* 24 (2.85%), and *P. saussurei* 11 (1.30%) following closely behind. In 1959, Khalaf was the first to document *P. americana* in Iraq. Based on prior investigations conducted by Abul-Hab (1972) and Garges and Adel (1987), the American cockroach and the German cockroach have been identified as among the most common species in Iraq. This conclusion was also agreed upon in previous studies (Lee and Yap, 1993; Benjapong et al., 1997; Sriwichai et al., 2001; Tawatsin et al. (2001); Tungtrongchitr et al. (2004); Saichua et al., 2008).

Abundance of cockroach Species in outdoor and indoor environments

Most *P. americana* specimens were found outside near pipes, sewers, and drains during the study period; they were also found inside the kitchen and toilets, which have a hot and humid environment. The present study confirmed the findings of Shahraki et al. (2013), Saad and Adel (1983), Sriwichai et al. (2001), and Memona et al. (2017). It was obtained by Sharawi et al. in 2021 from sewers in various areas of the Jeddah governorate in the Kingdom of Saudi Arabia. The study by Etim et al. 2013 showed that these cockroaches were captured from various locations in the home (toilets, kitchens, living rooms, and bedrooms).

Species abundance of cockroaches outdoors

Our results demonstrated that *S. lateralis* is more common outdoors, especially in gardens, garbage dumps, and manure piles. In contrast to the findings of Memona et al. (2017), they were found indoors during the study in various regions of Lahore, Pakistan. Although several reports (Alesho, 1997; Artyukhina& Sukhova, 1972) stated that the Turkestan cockroach occasionally lives inside, it is mostly found in animal dung heaps and the areas around garden buildings and under trash. *P. saussurei* was found in the sand near cooler mountain areas sources (Schall and Hamilton, 1990). Nasr et al. (2019) highlighted that numerous investigations have indicated that the species belonging to Polyphagidae inhabit cavities. Grandcolas (1996) concluded that some individuals of *P. saussurei* were found in cavities, while others were found burrowing in loose sand on the ground.

Species abundance of cockroaches in indoors

Our results show that both species, *B. germanica* and *S. longipalpa*, are found only in the kitchens of houses and apartments in the study area. The prevalence of German cockroaches in apartments may be attributed to the abundance of heat, water, and food sources (Schall and Hamilton, 1990). *S.longipalpa* was first recorded in Iraq in 1959 and has recently expanded nationwide (Khalaf, 1959). A study by Ali (2000) in the Bagdad discovered that both the *S. supellectilium* and *B. germanica* were present in apartment kitchens. This finding corresponds with Lee's (1995) search that *B. germanica* accounted for 100% of all cockroach infestations in the kitchens of most general hospitals in Korea. On the other hand, a recent survey by Nasirian (2016) in the Iranian cities of Ahvaz, Isfahan, and Tehran found that *S. longipalpa* is widely distributed in their kitchens. In Europe and America, the German cockroach predominates in multi-unit houses (Tomas and Robinsao, 1986). It was also recorded in Southeast Asia (Benjapong et al., 1997; Lee and Yap, 1993).

Morphological identification

Cockroaches have flat bodies and two pairs of wings folded flat on the back. However, most species can only rarely fly but can travel fast on their legs. They vary in color from light brown to black. Setaceous antenna type and chewing mouthpart type. There are three parts to a cockroach's body: the head, thorax, and abdomen. The head contains mouthparts, antennae, three simple eyes, and one pair of compound eyes. Each segment of the thorax is composed of a pair of legs. These measurements provide an overview of the physical characteristics of adult males and females of collected species. Male and female *P. americana* are oval and flattened in form. After the abdomen, the male wings expanded. The female wings are the same length as the abdomen. The male is generally longer and bigger than the female. This is where the male consistently has larger mean values than the female (Table 7). According to these findings, which agree with Sharawi et al. (2021), Hahn (2005), Perrot and Miller (2010), and Koehler and Bayer (2022).

(Table 7): Comparison of external morphological characters of males and females of *P. americana*.

Parameters	Adult (male)			Adult (female)		
	#	Range	Mean ± S.E	#	Range	Mean ± S.E.
Whole Body length	30	3.1680 - 4.1310	3.6829 ± 0.04811	30	3.3510 - 4.1830	3.6015 ± 0.03712
Head length	30	0.5160 - 0.6740	0.606767 ± 0.0074874	30	0.5250 - 0.7440	0.643233 ± 0.0085080
Head width	30	0.4110 - 0.5690	0.494567 ± 0.0066263	30	0.4380 - 0.5510	0.492133 ± 0.0048268
Thorax length	30	1.0680 - 1.6800	1.429000 ± 0.0275251	30	1.1640 - 1.6280	1.3709333 ± 0.02159331
Thorax width	30	0.8930 - 1.1290	1.040233 ± 0.0117859	30	0.9190 - 1.6190	1.043767 ± 0.0222168
Abdomen length	30	1.4180 - 1.9950	1.666400 ± 0.0300576	30	1.4180 - 1.8460	1.5873000 ± 0.02280684
Abdomen width	30	0.8580 - 1.3040	1.151700 ± 0.0160986	30	1.0760 - 1.4440	1.2583333 ± 0.01863468

*SE=Standard Error *# = number of specimens

The wings of the mature male *B. lateralis* are longer than the tip of the abdomen, and it is golden in color. Two pale wing stripes a distance less than the wings' width (Gurney and Fisk 1987). As shown in the table 8, female have broader heads, thoraxes, and abdomens in addition to longer bodies and heads than males, as seen in Table 9. Kim and Rust (2013) showed similar results.

(Table 8): Comparison of external morphological characters of males and females of *S.lateralis*

Parameters	Adult (male)			Adult (female)		
	#	Range	Mean ± S.E	#	Range	Mean ± S.E
Whole Body length	30	2.0220 - 3.1500	2.3564 ± 0.05298	30	2.2660 - 3.1590	2.7964 ± 0.03970

Head length	30	0.30600 - 0.45500	0.377167 ± 0.0072640 30	0.41100 - 0.64600	0.486267 ± 0.0075135
Head width	30	0.28100 - 0.41100	0.336233±0.0064970 30	0.3590-0.4640	0.399233 ± 0.0046947
Thoraxlength	30	0.7090 - 1.1550	0.8510433 ± 0.03225406 30	0.8050 - 1.2250	1.0428333 ± 0.02023052
Thorax width	30	0.5400 - 0.7790	0.638233 ± 0.0112548 30	0.7440 - 1.0500	0.9048333± 0.0131738
Abdomenlength	30	0.8750 - 1.6450	1.0993000 ± 0.03303611 30	1.0060 - 1.6190	1.2673333 ± 0.02486785

*SE=Standard Error *# = number of specimens

The adult of *B.germanica* has a brown to dark brown color and two parallel lines on its pronotum. The differences between the sexes include males having a slender body with a tapered abdomen and no tegmina covering the abdominal end segments. Females have a stout body with a rounded posterior abdomen and an entire abdomen covered by tegmina, as shown in Table 9. Similar to the findings of Kim et al. (2017), the data presented below revealed that the length and width of the heads, thoraxes, and abdomens of male and female *B. germanica* differ slightly.

(Table 9): Comparison of external morphological characters of males and females of *B. germanica*

Parameters	Adult (male)			Adult (female)		
	#	Range	Mean ± S.E	#	Range	Mean ± S.E
Whole Body length	20	1.3740 -1.7950	1.5051± .02283	20	1.2090 - 1.7150	1.4522 ± 0.03059
Head length	20	0.2010 - 0.2630	0.239550 ± 0.0039473	20	0.2100 - 0.2980	0.260350 ± 0.0053672
Head width	20	0.1750 - 0.2540	0.204050 ± 0.0046693	20	0.2100 - 0.2880	0.230600 ± 0.0038807
Thorax length	20	0.4290 - 0.6830	0.508100 ± 0.0152033	20	0.4290 - 0.6210	0.5565500 ± 0.01276683
Thorax width	20	0.3410 - 0.5430	0.399550 ± 0.0106557	20	0.3850 - 0.4810	0.429350 ± 0.0055281
Abdomen length	20	0.6650 - 0.8490	0.757500 ± 0.0111647	20	0.4990 - 0.8660	0.6353500 ± 0.02704531
Abdomen width	20	0.3590 - 0.4900	0.397750 ± 0.0073488	20	0.5160 - 0.8310	0.6683500 ± 0.06019684

*SE=Standard Error *# = number of specimens

S. longipalpa's colors range from light brown to brown, while females are darker. The adult's wings have a pale brown band running across the base of them. A second band also crosses the body. Males can fly and have wings that fully cover their abdomen. Females cannot fly because their wings do not cover their whole abdomen. *S. longipalpa* females are somewhat longer than males. Adult females have somewhat broader heads than adult males, who have longer heads. Average mature females have longer and broader thoraxes than males. Adult females have larger abdomens than adult males, who have somewhat longer abdomens (Table 10). The sexes differ, as stated by (Nasirian , 2016).

(Table 10): Comparison of external morphological characters of males and females of *S. longipalpa*

Parameters	Adult (male)			Adult (female)		
	#	Range	Mean ± S.E	#	Range	Mean ± S.E
Whole Body length	13	1.3390 - 1.5660	1.4433 ± 0.02361	6	1.3910 -1.5840	1.4920 ± 0.03426
Head length	13	0.1490 - 0.2540	0.221462 ± 0.0079531	6	0.1750-0.2100	0.201333 ± 0.0059535
Head width	13	0.1840-0.2100	0.196615 ± 0.0024950	6	0.2010-0.2280	0.211500 ± 0.0042953
Thorax length	13	0.4460-0.5690	0.5109231 ± 0.01088781	6	0.5250-0.6560	0.5878333 ± 0.01909872
Thorax width	13	0.3760- 0.5340	0.437615 ± 0.0115833	6	0.4290-0.6300	0.510667 ± 0.0315517

Abdomen length	13	0.6130-0.7880	0.7102308 0.01617221	± 6	0.6390-0.7960	0.702833 ± 0.02530536
Abdomen width	13	0.3410-0.4810	0.4100000 0.01025883	± 6	0.5160-0.6040	0.5820000 ± 0.01395230

*SE=Standard Error *# = number of specimens

Both sexes of *P. saussurei* are black all over. Male wings are completely formed and lighter than those of the other body, extend beyond the abdomen, and are widely rounded at the distal end, while females are wingless and have short antennae and cerci (Hashemi-Aghdam & Oshaghi, 2015). Based on the provided data, female *P. saussurei* are generally larger than males, with longer body length, a longer thorax, and a wider thorax and abdomen. Head length and width are also slightly larger in female (Table 11).

Table (11): Comparison of external morphological characters of males and females of *P. saussurei*

Parameters	Adult (male)			Adult (female)		
	#	Range	Mean ± S.E	#	Range	Mean ± S.E
Whole Body length		2.171 - 3.125	2.71 46 ± 0.11528	2	3.063 - 4.305	3.6840 ± 0.62100
Head length	7	0.3240 - 0.4460	0.386571±0.0206454	2	0.5200 - 0.5250	0.522500 ± 0.0025000
Head width	7	0.3150-0.4640	0.387571±0.0223967	2	0.5200 - 0.5250	0.522500 ± 0.0025000
Thorax length	7	0.8930-1.3740	1.1665714±0.06713911	2	1.1380 - 1.8550	1.4965000 ± 0.35850000
Thorax width	7	0.8310-1.1200	0.996286±0.0382689	2	1.9600 - 2.0650	2.012500 ± 0.0525000
Abdomen length	7	0.9450-1.3480	1.1614286±0.06620957	2	1.4000 - 1.9250	1.6625000 ± 0.26250000
Abdomen width	7	0.9630-1.3560	1.1538571±0.05683453	2	1.7500 - 1.9160	1.8330000 ± 0.08300000

*SE=Standard Error *# = number of specimens



Fig 2: Ventral view of an adult *P.americana* male



Fig 3: Dorsal view of an adult *P.americana* male



Fig 4: Ventral view of an adult *P.americana* female



Fig 5: Dorsal view of an adult *P.americana* female



Fig 6: Ventral view of an adult *S.lateralis* male



Fig 7: Ventral view an adult of *S.lateralis* male

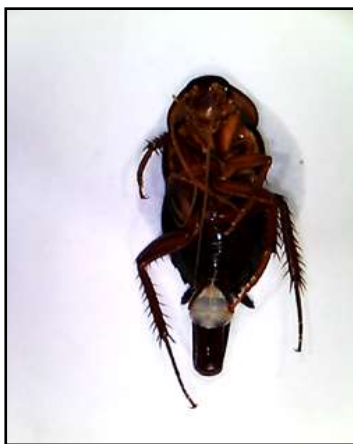


Fig 8: Ventral view of an adult *S. lateralis* female



Fig 9: Dorsal view of an adult *S. lateralis* female



Fig 10: Ventral view of an adult *B. germanica* male



Fig 11: Dorsal view of an adult *B. germanica* male



Fig 12: Ventral view of an adult *B. germanica* female



Fig 13: Dorsal view of an adult *B. germanica* female



Fig 14: Ventral view of an adult *S. longipalpa* male



Fig 15: Dorsal view of an adult *S. longipalpa* male



Fig 16: Ventral view of an adult *S.longipalpa* female



Fig 17: Dorsal view of an adult *S.longipalpa* female



Fig 18: Ventral view of an adult *P. saussurei* male



Fig 19: Dorsal view of an adult *P. saussurei* male



Fig 20: Ventral view of an adult *P. saussurei* female



Fig 21: Dorsal view of an adult *P. saussurei* female

Conclusion

The present study provided information on cockroach species and their habitat, distribution, and external morphology characteristics for both genders in each species in Kurdistan Region, Iraq. During the period of the survey, five species of cockroaches were identified as follows: *P. americana*, *S. lateralis*, *B. germanica*, *P. saussurei*, and *S. longipalpa*, with *P. americana* being the most prevalent. The obtained species live in various habitats, and the infestation rate of each species is determined by the availability of food products as well as hygienic and environmental conditions.

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