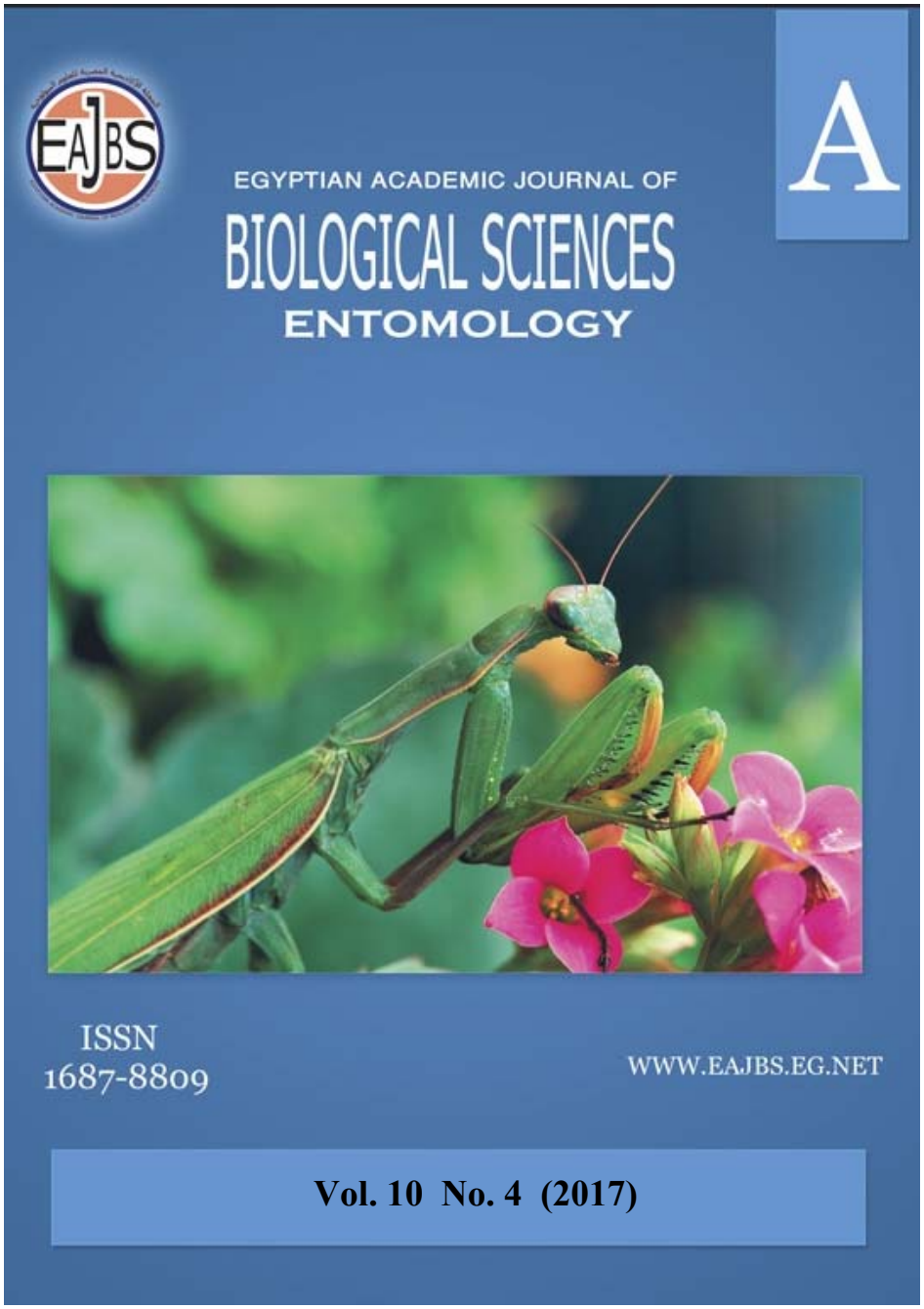

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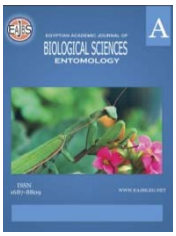

A Simplified Identification key of Egyptian Sandfly Species

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ABSTRACT

The main objective of this study is to simplify the identification of sandflies of Egypt so that, a simple illustrated key was prepared for 9 *Phlebotomus* and 13 *Sergentomyia* species representing the sandfly fauna of Egypt.

INTRODUCTION

Phlebotomine sandflies are small blood sucking insects belonging to order Diptera, suborder Nematocera, family Psychodidae and subfamily Phlebotominae. Sandflies are known as vectors of a viral disease (Sandfly fever or three-day fever), a bacterial disease (Carrion's disease or Bartonellosis) and protozoal diseases (Cutaneous leishmaniasis, CL and Visceral leishmaniasis, VL).

In Egypt the medical importance of sandflies is significant because some of them are vectors of CL or VL. *Phlebotomus langeroni* is the proven vector of VL (*L. infantum*) in El Agamy and Northern west coast of Egypt (El Sawaf *et al.*, 2012; Doha and Shehata, 1992). In Sinai Peninsula, two forms of CL are present "wet and dry sore ". *P. papatasi* is the proven vector of *L. major* and *P. sergenti, P. alexandri* and *P. bergeroti* are potential vectors of L. *tropica* (Doha *et al.*, 1994; 2014). *P. langeroni* and *P. papatasi* were recorded from El Agamy, Alexandria Governorate (El .Sawaf *et al.*, 1984) and *P bergeroti* from Sinai (El Sawaf *et al.*, 1987). Lane (1986) reviewed the sandfly fauna of Egypt and described eight Phlebotomus species: *P. papatasi, P. bergeroti, P. alexandri, P. sergenti, P. kazeruni, P. orientalis, P. arabicus* and *P. major* and 13 *Sergentomyia* species namely *S. tiberiadis , S. adleri , S. clydei, S. schwetzi , S. palestinensis, S . minuta, S. antennata, S. taizi, S. fallax, S. squamipleuris*, *S. christophersi, S. cincta* and S. *theodori*. With *P. langeroni*, it is considered that 22 sandfly species are identified till now in Egypt (9 belonging to genus *Phlebotomus* and 13 to genus *Sergentomyia*).

The identification of sandfly species requires skilled personnel due probably to their minute size and great similarities in their taxonomic characters. The objective of this work is to design a key that is simple and easy to use for identification of the different sandfly species of Egypt.

MATERIALS AND METHODS

The illustrations of Lewis (1982), Lane (1986) and El Sawaf *et al.* (1985) were used in design and preparation of the present key.

RESULTS

The designed key is presented in Figures 1 (Plates A1-A7 for genus *Phlebotomus*) and 2 (Plates B1-B9 for genus *Sergentomyia*).

DISCUSSION

In Egypt Phlebotomine sandflies are vectors of sandfly fever virus and two forms of leishmaniases (CL and VL), for this reason the correct identification of the sandfly species is crucial and plays an important role in the course of the epidemiology of the disease transmission and the development of control programs. In the present study, the designed key simply illustrates the morphological characters that are used in sandfly identification. Detailed characters of the *P. langeroni* female were illustrated (El Sawaf *et al.,* 1985) since the identification of this particular species was based on the male characters in previous keys (Nitzulescu and Nitzulescu, 1933).This key can be of help in the species identification of all sandflies recorded in Egypt.

CONCLUSION

We have produced an illustrated key that is accessible to the non-taxonomist interested in the field of diseases transmitted by sandflyies. In this key the horizontal presentation of the sandfly species facilitates comparison between the different 9 *Phlebotomus* and 13 *Sergentomyia* species present in Egypt.

ACKNOWLEDGMENTS

We express gratitude to Dr Mohamed A. Kenawy, Prof. of medical entomology-Ain Shams University, Faculty of Science, Entomology Department, for his constant help during our sandfly work.

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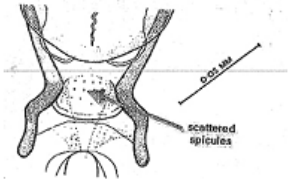
Fig. 1: Key to the species of Phlebotominae in Egypt

A Genus *Phlebotomus*

In *Phlebotomus* the cibarium is unarmed (no teeth) or with scattered spicules without a pigment patch.



In *Phlepotomus,* hairs (setae) on the posterior margins of the abdominal tergites 2-6 are erect, and their sockets are large and round as on abdominal tergite 1 In *Phlepotomus,* hairs (setae) on the posterior margins of the abdominal tergites 2-6 are erect, and their sockets are large and round as on abdominal tergite 1

Hind end of dorsal surface of abdomen.

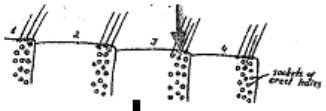


Plate A1

In *Phlebotomus* the style has 4 or 5 spines.

B Genus *Sergentomyia*

In *Sergentomyia* the cibarium has one or more rows of teeth pigment patch is usually present.

In *Sergentomyia* generally, hairs (setae) on the posterior margins of abdominal tergites 2-6 are recumbent, their sockets are much smaller than abdominal tergite 1 and they are tear shaped. However, there are few *Sergentomyia* species with erect hairs.

Fig. 2

In male *Sergentomyia* the spines on the style are terminal and may vary in number from 4 to 5.

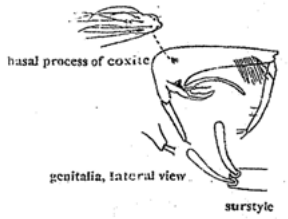
Plate A1 (Genus *Phlebotomus*)

Male *Phlebotomus*

-Style with five short tooth - like spines.
-Surstyle with spines apically.
-Paramere with three lobes.

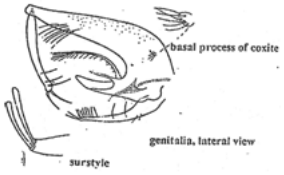
-Eye appearing small because head relatively short.
-Small basal tubercle on coxite with non-deciduous hairs.
-Distance between basal and middle spines less than that between middle and distal spines.
-Surstyle with only 2 spatulate spines at tip.

P. papatasi



-Eye appearing large because head relatively long.
-Distance between basal and middle spines greater than or equal to that between middle and distal spines.
-Distal spines of surstyle long and thin.

P. bergeroti



-Style with five long spines.
-Surstyle without spines apically.
-Paramere simple.

Coxite with basal lobe bearing long hairs.

Plate A2

Coxite without basal lobe

Plate A3

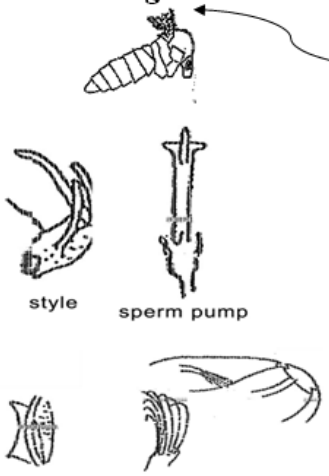
Female Phlebotomus

Plate A5

Plate A2

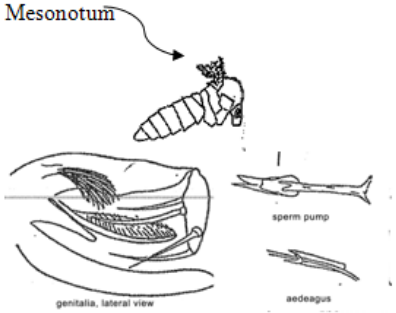
-Style less than half length of coxite.
-Mesonotum pale.
-A3 long.
-Tip of aedeagus pointed.

P. sergenti



-Style about half length of coxite (about four times as long as thick).
-Mesonotum dark. (brown)
-Tip o f aedeagus appearing rounded or prowshaped in side view.

P. kazeruni



-Basal coxite tuft short and broad.
-One spine of style terminal, the next at 0.7.
-A3 short and thick.
-Sperm pump 0.12 mm long with small funnel.

P. alexandri

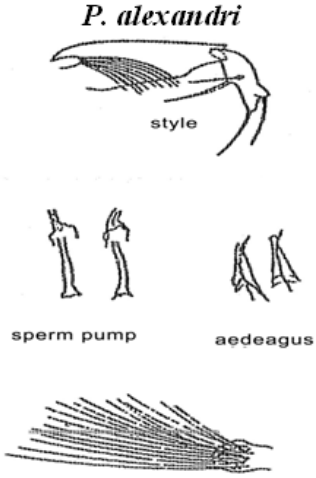
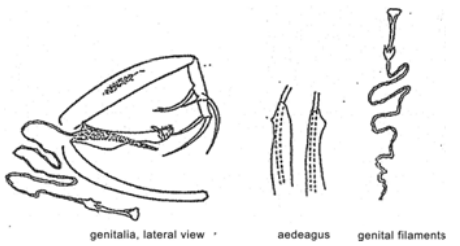


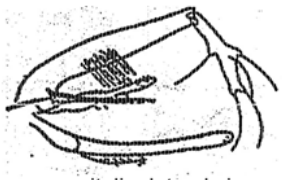
Plate A3

-Aedeagus with keel just before tip.
-Coxite with hair group of more than 30 (50-60) hairs; sperm ducts with transverse ridges more than eight times pump length.
- Mesonotum very pale.
-Genital filaments usually very long.
-Sand fly large.

P. arabicus



-Aedeagus smooth to tip; hair group less than 20 hairs; sperm ducts smooth, less than 5 times pump, length.



-Two ascoids on antennal segments 8-12 (3-12).
-Tip of aedeagus ventral and mesad.
-Parameres finger-like, surstyles longer than coxites, coxites slender.

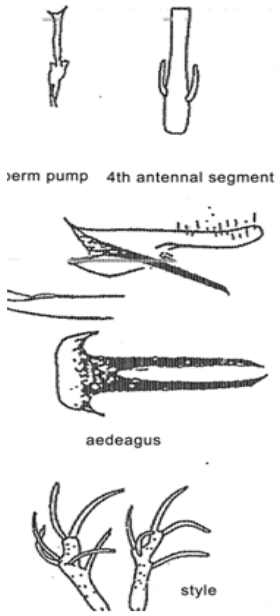
-Antennal segments 3-7 with two ascoids.
-One ascoid on antennal segments 8-12.
-Tip of aedeagus dorsal and lateral.
-Pharynx narrowing slightly after posterior bulge, armature a series of short transverse ridges of minute denticles extending 0.20-0.26 length of pharynx.

Plate A4

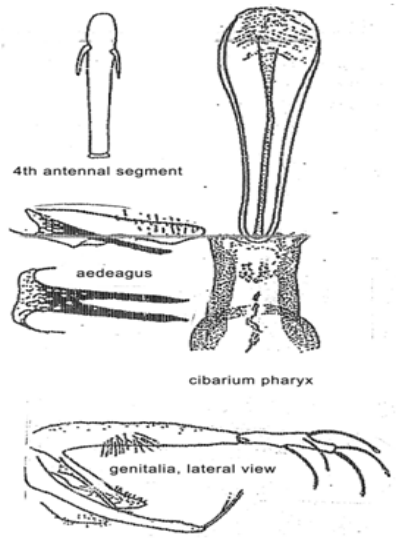
-Two ascoids on antennal segments 3-8.
-Tip of aedeagus like drum stick.
-Aeadeagus with rounded end.

Plate A4

P. langeroni



P. orientalis



P.major

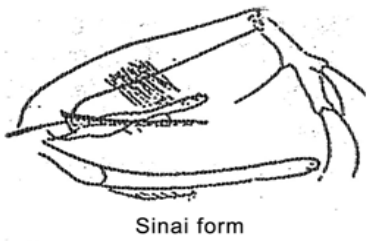
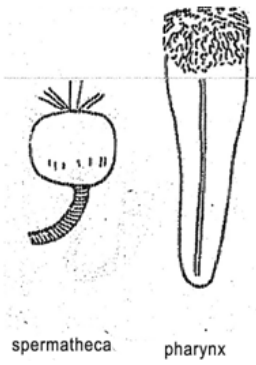


Plate A5

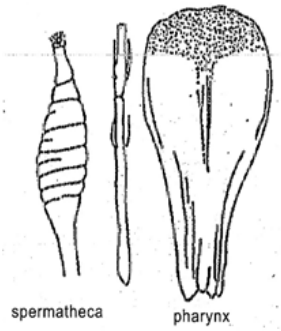
-Spermathecae with single segmented capsule, its body about as long as wide.
-Mesonotum brown.
-Pharynx narrow, with scale like armature, posterior margin of hind scales minutely serrated.

P. kazeruni



-Spermathecae delicate elongated, ovoid and incompletely striated with small terminal knob and thick individual duct.
-Pharynx narrowing after posterior bulge, rounded posteriorly, armature a series of long backward-pointed teeth.
-A3 slender, as long as labrum.

P. arabicus



-Spermathecae distinctly segmented.

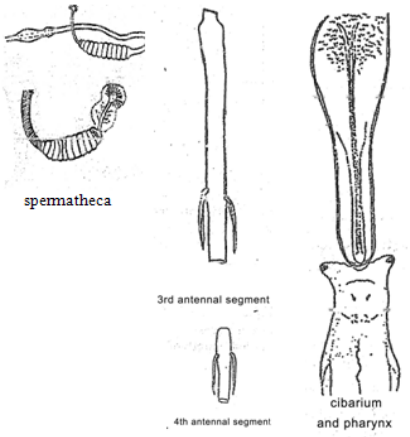
Spermathecae segmented with long neck → **Plate A6**

Spermathecae segmented without neck → **Plate A7**

Plate A6

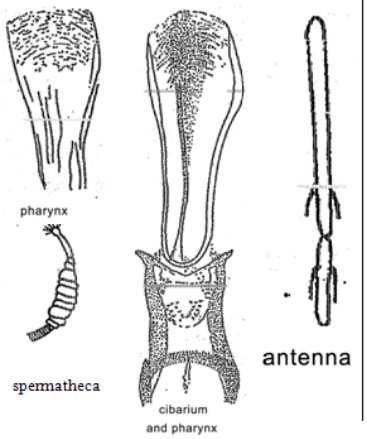
-Spermathecae with segments unequal in size, middle segments larger than others, apical, segment long.
–Ascoids on A4 more than 0.5 length of segment.

P. langeroni



-Ascoids on A4 less than 0.4 length of segment.
-Spermathecae with 10 (8-12) segments.
-Asoids paired on segments 3-15.
-Pharyngeal armature consisting of irregular rows of 9 pin-like teeth.
–Pharynx with indistinct posterior margin.

P. orientalis



-Pharyngeal armature composed of rows of minute teeth or ridges.
–Pharyngeal armature extending to half length of pharynx.

P. major **"Sinai form"**

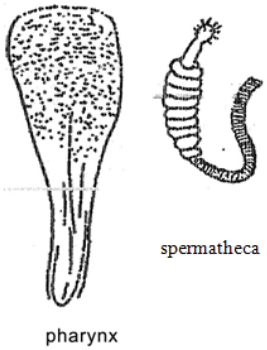
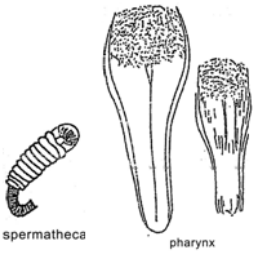


Plate A7

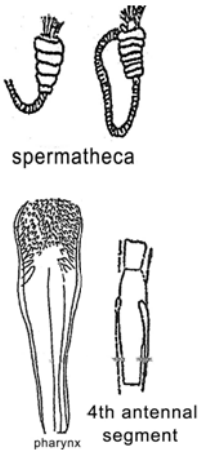
-Pharyngeal armature composed of rows of minute teeth or ridges and not extending beyond posterior third of pharynx.
-Spermathecae with segments subsequel, apical segment short.
-Pharyngeal armature composed of rows of minute teeth or ridges and not extending beyond posterior third of pharynx.
-Spermathecae with segments subsequel, apical segment short.

P. papatasi



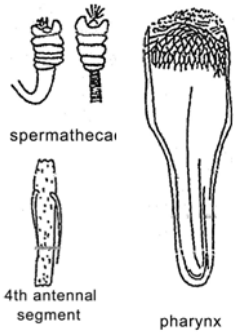
-Most pharynngeal scaly teeth arranged obliquely and pointing backward.

P. bergeroti



-Pharyngeal armature composed of broad scale-like teeth.
-Pharynx intented posteriorly; ascoids on A3 and A4 long and slender, almost reaching end of segment; combined length of A3+A4 longer than labrum.
-Spermathecae with four or five segments

P. sergenti



-Pharyngeal armature composed of broad scale-like teeth.
-Pharynx triangular, lateral and posterior margins straight.
-Ascoids on A3 and A4 short and stout; combined length of A3+A4 shorter than Labrum.

P. alexandri

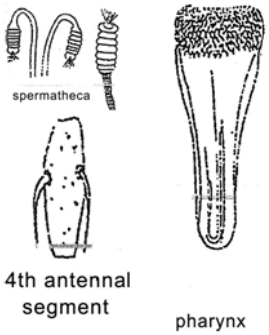
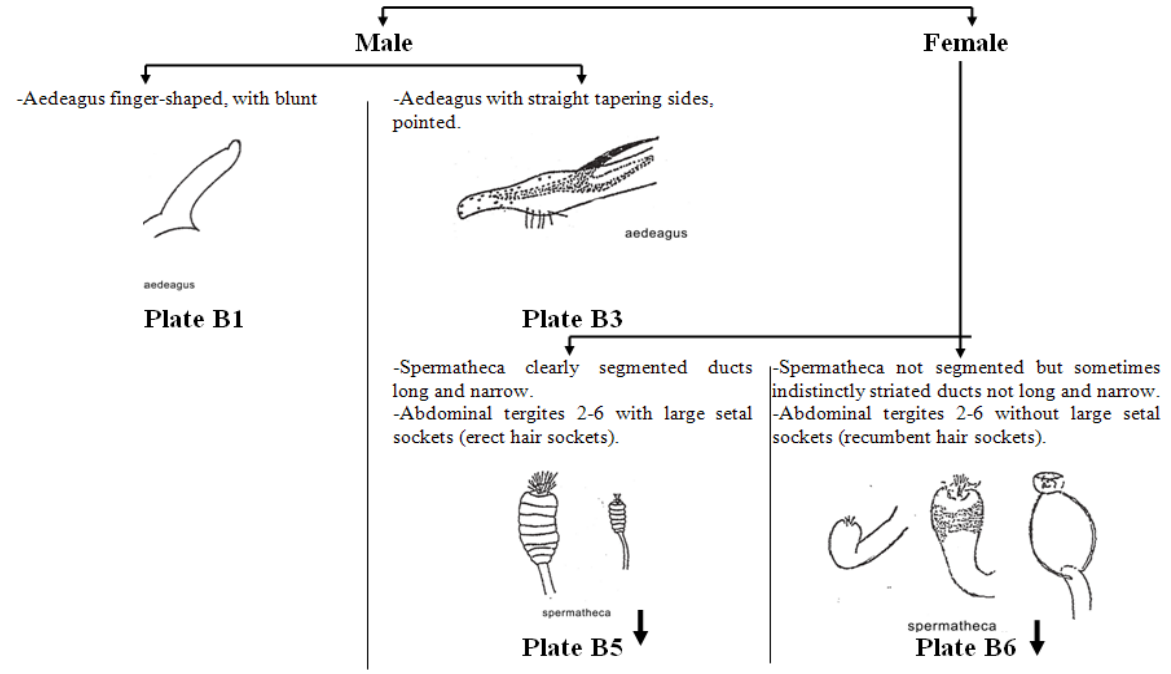


Fig. 2: Genus *Sergentomyia*



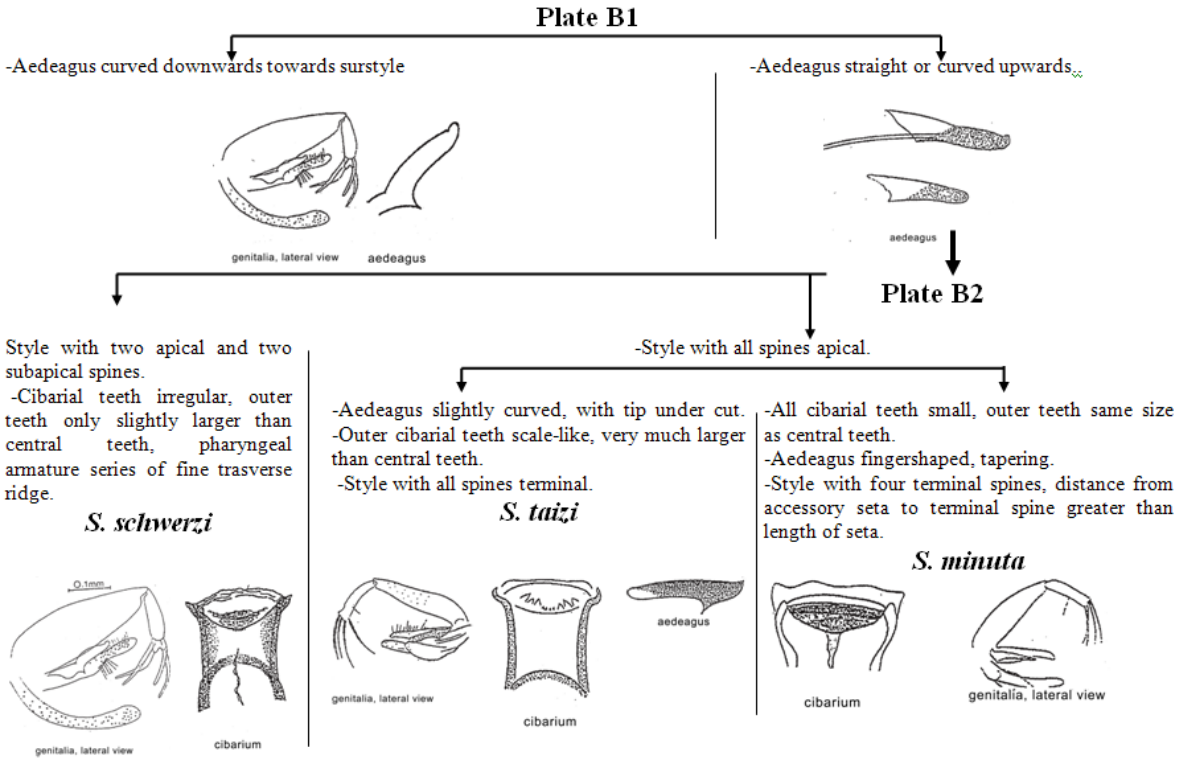
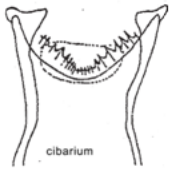


Plate B2

-Cibarium with 18-22 teeth, the central teeth distinctly smaller than lateral teeth.

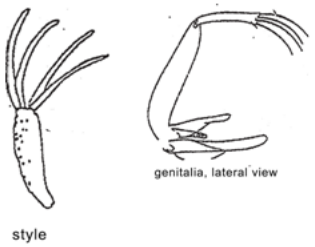
S. theodori



Cibarium with 16-18 subequal teeth.

-Style slender, five to seven times as long as wide. accessory seta on style close to apical spines.

S. fallax



-Style stout, four times as long as wide, accessory seta at about 0.75 style length.

S. antennata* and *S. cincta

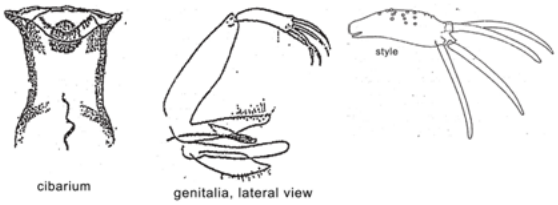
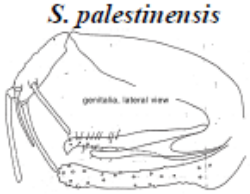


Plate B3

-Aedeagus truncated, style with two subterminal and two terminal spines.

-Cibarium with straight row of 12 teeth.

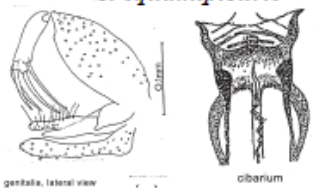
S. palestinensis



-Aedeagus tapering to pointed tip, all spines on style terminal

Cibarium with small process in front of teeth, mesanepimeron with setal sockets; aedeagus short and gently tapering.

S. squamipleuris



Cibarium without any process, mesanepimeron without setal sockets, aedeagus otherwise.

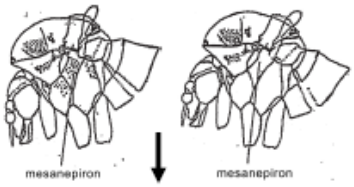
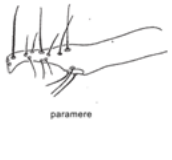


Plate B4

Plate B4

-Mesonotum very pale.
-Cibarium with convex row of uneven-sized, curved horizontal teeth (12-14).
-Surstyles only slightly longer than parameres.

S. tiberiadis



-Cibarium with straight horizontal teeth

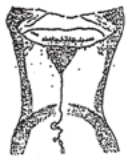
-Cibarium with 3-4 horizontal teeth and some denticles and large cornua.

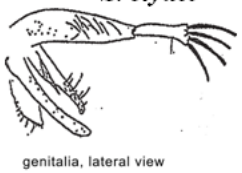
S. christophersi

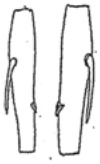
Cibarium with 16-26 fine horizontal teeth, cornua small (not wider than long).

-Cibarium with single row of vetical (fore) teeth, horizontal (hind) teeth usually comprising 25-35 denticies in small groups, occasionally discrete teeth.

S. clydei







-Cibarium with two or three rows of verical (fore) teeth, six in each. Horizontal (hind) teeth usually well developed. (always discrete).

S. adleri

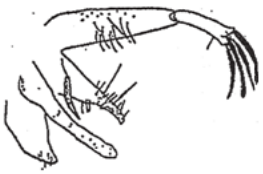


Plate B5

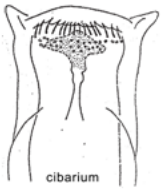
Cibarium with 4-5 long slender widely spaced horizontal teeth (numerous spicules may also be present).

S. christophersi

Cibarium with 12-14 closely packed horizontal teeth.

Cibarium with strong, curved horizontal teeth, those at the sides longer than central teeth.

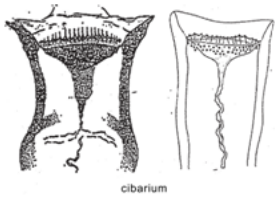
S. tiberiadis



Cibarium with straight, closely packed horizontal teeth.

Cibarium with 40-80 vertical teeth in 3-5 rows, more than 20 horizontal teeth.

S. adleri



Cibarium with 12-30 vertical teeth in one or two rows, 12-13 horizontal teeth.

S. clydei

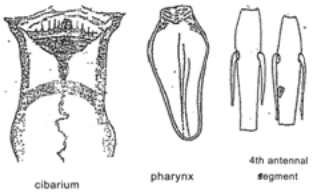
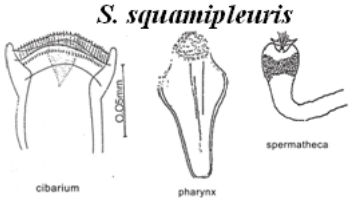


Plate B6

-Spermatheca with capsule covered in numerous small spicules, cibarial teeth in convex row.

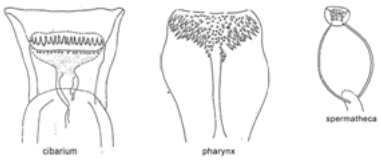
S. squamipleuris



-Spermatheca smooth, without spicules, cibarial teeth in straight or concave row.

-Spermatheca with capsule, well-developed cibarial teeth in straight row.
-Cibarium with 22 teeth. Pharyngeal teeth stout.

S. palestinensis



-Spermatheca simple, tubular.
-Cibarial teeth not straight and palisade-like.

-Cibarium with 50-60 equal-sized, horizontal teeth in a comb-like row.

S. minuta

-Horizontal cibarial teeth either unequal or row concave.

-Cibarium with central horizontal teeth at least half size of lateral horizontal teeth.

Plate B7

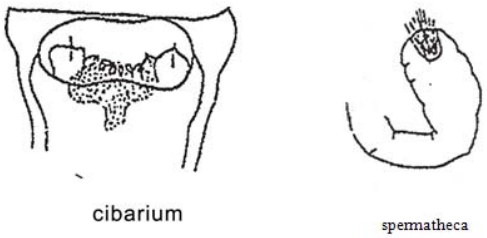
-Cibarium with all horizontal teeth subequal or lateral teeth only slightly larger than medial teeth.

Plate B8

Plate B7

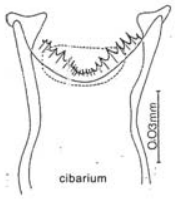
Cibarium with lateral horizontal teeth scale-like, very much larger than medial horizontal teeth.

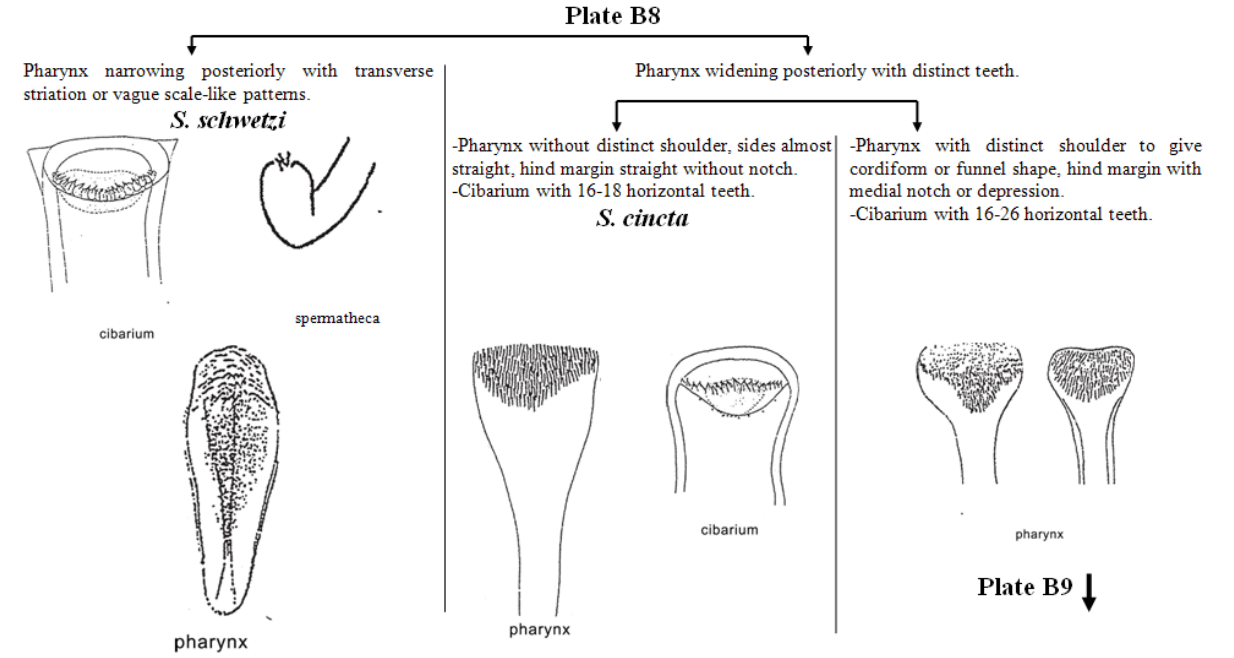
S. taizi

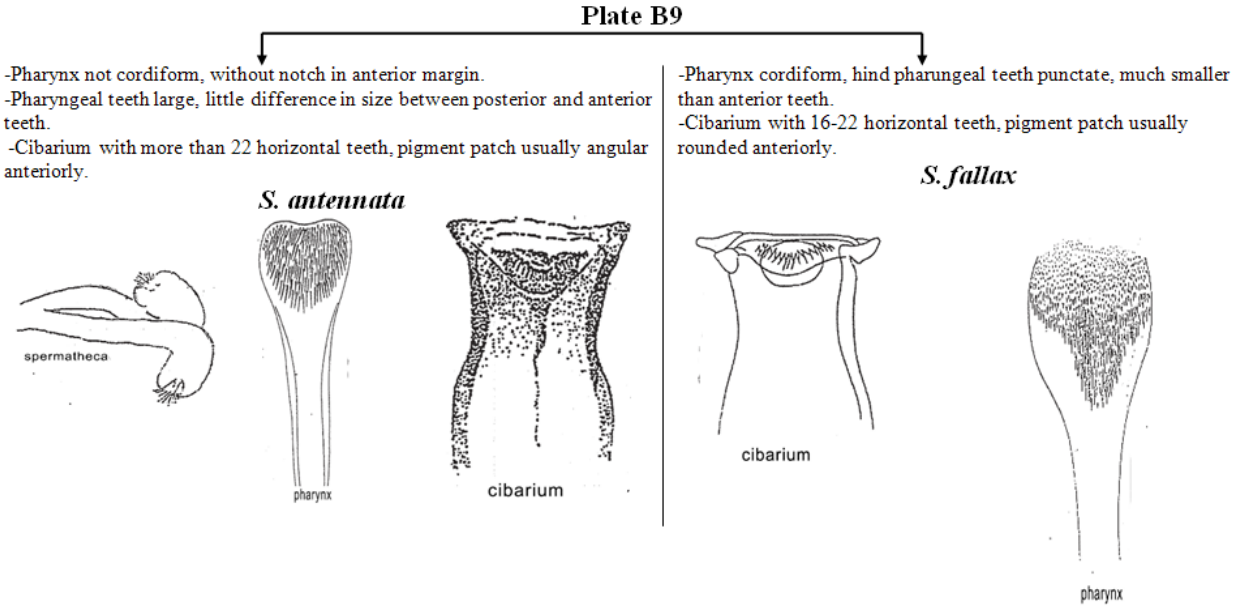


Cibarium with lateral horizontal teeth same shape as medial horizontal teeth.

S. theodori







ARABIC SUMMARY

مفتاح بسيط لتشخيص انواع ذباب الرمل المصرى

سناء عبد الستار[1] - سعيد ضحا[1] - شعبان الحصرى[1] - بهيرة الصواف[2]

١- مركز الأبحاث والتدريب لناقلات الأمراض ، جامعة شمس القاهرة ، مصر.

٢- قسم علم الحشرات ، كلية العلوم ، جامعة شمس ، القاهرة ، مصر.

الهدف الرئيسى لهذه الدراسة هو تبسيط تشخيص ذباب الرمل المصرى لغير المتخصصين لذا تم عمل مفتاح لتسعة انواع من جنس فليبوتومس وثلاثة عشر من جنس سرجانتومايا والتى تمثل انواع ذباب الرمل فى مصر.