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The mosquito fauna of Kuwait

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ABSTRACT

Although Kuwait is considered to be a receptive area for mosquito borne-diseases, no indigenous cases of malaria or filariasis have yet occurred in the country. To protect Kuwait from active transmission of these diseases, country-wide entomological surveys have been carried out since 1975 by the Insect and Rodent Control Division, Ministry of Health, to detect mosquito species composition and their breeding sites to be followed up by control measures.

Two anopheline species and eight culicine species of mosquitoes have been recorded in Kuwait. Since 1981, *Anopheles* (*Myzomyia*) *stephensi* and *A.* (*Myzomyia*) *pulcherrimus* have been encountered in their breeding places, associated with *Culex* (*Barraudius*) *pusillus*, *C.* (*Culex*) *univittatus* and *C.* (*C*) *theileri*. Larvae of *C.* (*C*) *tritaeniorhynchus* have been found in small numbers since 1987. *C.* (*C*) *pipiens* complex (*molestus* and *quinquefasciatus*) is the prevailing species, whereas *Culiseta longiareolata* ranks second. *Aedes caspius* is the only species of the genus *Aedes* to be found in Kuwait. Keys for the larval and adult stages of these species are given.

INTRODUCTION

Kuwait covers an area of 17,881 km^2 occupying the north-western corner of the Arabian Gulf and extending about 200 km from its northern to southern boundaries. The country has a comparatively low number of mosquito species compared with other regions of the Arabian Gulf. This may be attributed, as mentioned by Salit (1989) mainly to the arid climate (Fig. 1), the scarcity of natural fresh water, and shortage of fertile soil—as indicated from records of the Ministry of Electricity and Water, Kuwait (1988) and the Administration of Agriculture and Fish Resources, Kuwait (1985, 1987). Nevertheless, growth and development projects, including urbanization and development of water resources have led to the creation of permanent and temporary breeding sites for mosquitoes which are a nuisance in both agricultural and urban areas of the country as well as being potential vectors of disease (Salit 1989). Moreover, irrigation management in agricultural areas aims at reducing water loss by seepage, evaporation and/or use by weeds, rather than at reducing breeding sites for mosquitoes. There are three main sources of water in Kuwait: these are underground water, desalinated sea water, and treated sewage

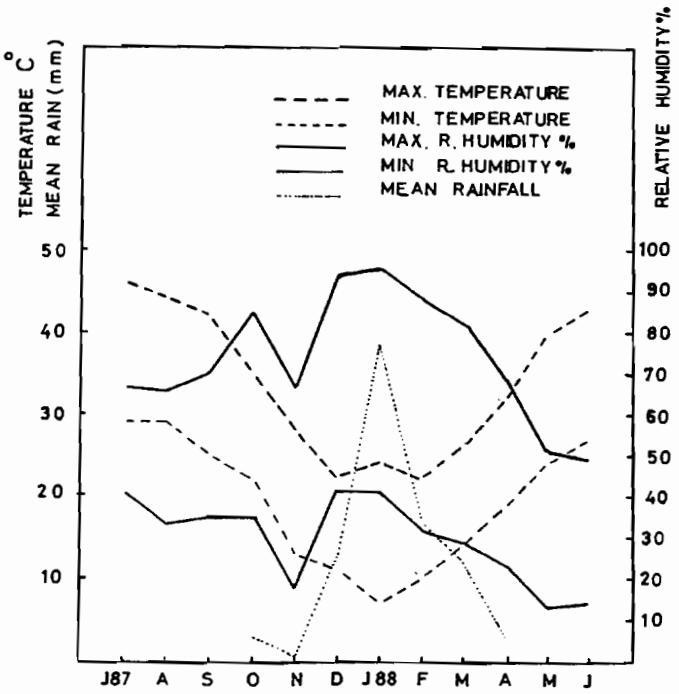

Fig. 1. Temperature relative humidity and rainfall in Kuwait 1987/88.

water. These may all create favourable breeding sites for different species of mosquitoes. Although Kuwait is situated in close proximity to malarious countries viz. Saudi Arabia and Iraq, as well as to farms which provide places favourable for the breeding of *Anopheles* mosquitoes, Kuwait remains one of the malaria-free countries in the Mediterranean Region (Rathor 1988). This may be attributed mainly to the infrequent entry of infected mosquitoes. The protection of Kuwait from malaria and other mosquito-borne diseases is the responsibility of the Insect and Rodent Control Division, Ministry of Health. Country-wide entomological surveys have been carried out by the specialized units of this Division since 1975.

MATERIAL AND METHODS

METHODS FOR COLLECTING MOSQUITO LARVAE

Mosquito larvae are collected on a country-wide basis all year round, using a circular water net formed of an iron ring about 20 cm in diameter, attached to a stick about 1 m long, and with a bag of fine muslin about 25 cm long tapering to a rounded point. A large galvanized iron ladle with a bowl about 10 cm in diameter was used for collecting larvae from small water bodies. The larvae collected by the net or ladle were emptied in a shallow white dish 20 cm in diameter, placed in bottles of water and transported to the laboratory from the breeding place. Descriptive details were entered on special forms by the collector.

EXAMINATION OF LARVAL SAMPLES AND THEIR BREEDING

Samples of water from the different breeding places were tested in the laboratory for pH, Biological Oxygen demand (BOD), and dissolved salts. The larvae were identified as far as possible: those of common species could be easily identified from larval characters alone. The larvae of less common species were placed in earthenware dishes about 20 cm in diameter and 5 cm in depth with a steady water level from their natural environment, and left for the adults to emerge. The dishes were kept inside cages of fine meshed mosquito netting on wooden frames with glass tops. A sleeve was sewn into one side of each cage so that the hand could be inserted to collect the emerged adult mosquitoes for examination. Keys for larval and adult stages of mosquitoes in Kuwait are based on the descriptions given by Kirkpatrick (1925), Mattingly and Knight (1956), Pratt (1967) and Harbach (1985).

RESULTS AND DISCUSSION

Two anopheline and eight culicine species of mosquitoes were recorded. These were identified and classified as follows:

Order: Diptera
Family: Culicidae
I—Subfamily: Anophelinae
Anopheles (*Myzomyia*) *stephensi* Liston
Anopheles (*Myzomyia*) *pulcherrimus* Theobald
II—Subfamily: Culicinae
Culex (*Culex*) *pipiens* Linnaeus
molestus Forsk.
Culex (*Culex*) *quinquefasciatus* Say
Culex (*Culex*) *tritaeniorhynchus* Giles
Culex (*Culex*) *theileri* Theobald
Culex (*Culex*) *univittatus* Theobald
Culex (*Barraudius*) *pisillus* Macquart
Culiseta (*Allotheobaldia*) *longiareolata* Macquart
Aedes (*Ochierotatus*) *caspius* Pallas

An early mosquito survey in Kuwait by Pringle (1952) revealed no anopheline mosquitoes. Although this author was informed that Byres had collected a few specimens of *Anopheles pulcherrimus* and *Anopheles pretoriensis* during the summer of 1951, none of these were available for examination.

The country-wide entomological survey, which began in 1975 did not record any anopheline larvae in Kuwait until November 1981 when 425 *Anopheles stephensi* larvae were detected and their identification confirmed. Since then, despite the treatment of actual and potential breeding places with larvicides in addition to routine ULV space spraying, the distribution of *A. stephensi* larvae has expanded. Moreover, from 1982 onwards, the densities of *A. pulcherrimus* larvae have also increased (Table 2). The two anopheline species have established themselves in farms bordering urban areas. In addition *A. stephensi* has been breeding inside the capital.

This calls for special attention since *A. stephensi* is known to be a successful vector of urban malaria in other parts of the world (Rathor 1988).

Although certain authors consider *A. pulcherrimus* to be a vector of malaria at an epidemiological level in certain areas, such as in southern parts of USSR (Covell 1944) and northern Afghanistan (Onori 1975), dissections of adult female mosquitoes of this species made in malarious areas of India and Pakistan have all been negative (Ramachandra Rao 1984). However, as mentioned by (Pringle, 1952) and Abul-Hab (1979) it appears that *A. pulcherrimus* plays no part in the transmission of malaria in the malarious countries of the Gulf area. These authors point out that *A. pulcherrimus* tolerates an arid environment and breeds in water with up to 6000 ppm chlorides. This indicates its ability to establish itself around Kuwait where surface water collections persist since none of these contains so much chlorides (Table 1).

Culex pipiens is the prevailing species of mosquito in both urban areas and the surrounding farms of Kuwait. It exhibits homodynamicity (breeds all the year), and breeds in a wide range of breeding places including waters with relatively high contents of decaying organic matter. Salit (1989) proposed that these biological characters, in addition to the intimate association of this mosquito with man, its anthropophilic behaviour, stenogamy and autogenicity, strongly suggest that the subspecies is *C. pipiens molestus* Forsk. Further investigation is needed. This is the most common subspecies in the Mediterranean areas of the Palearctic Region including the Middle East, and is known to be the main vector of wuchererian filariasis in endemic temperate areas. The other subspecies, *C. pipiens quinquefasciatus* Say, has been found in association with populations of *C. pipiens molestus* in water containing comparatively little organic matter. This subspecies is also a vector of wuchererian filariasis in endemic areas.

A few larvae of *C. tritaeniorhynchus*, the known vector of the Japanese Encephalitis (JE) virus in endemic areas, were encountered near the eastern borders of Saudi-Arabia in 1987. Since then, a few more larvae have been found, particularly in the autumn months, in non-polluted or slightly polluted waters (Table 2). Pringle (1952) points out that this species tolerates water containing up to 4000 ppm chlorides. This indicates its ability to establish itself in surface water in and around Kuwait (Table 1).

The other *Culex* species found in Kuwait have been encountered at low densities.

Table 1. Range and mean of water quality parameters in Kuwait, 1987.

Sources	pH	T.D.S.* ppm.	Chlorides ppm.
Underground	7.5–7.6	3685–4680	902–944
(Brackish)	(7.6)	(3932)	(921)
Desalinated	9.7–8.5	424.4–465.6	79.6–104.8
(Fresh)	(8.8)	(438.5)	(88.5)
Tertiary treated	6.9–8.3	1791.2–2150.4	399–467
Sewage	(7.6)	(2012)	(426)
WHO specifications	6.5–8.5	Max. 500	Max. 200

Annual Report, Division of Protection of Water Pollution, Environmental Protection Administration, Kuwait, 1987.

pH for irrigation 6.5–8.5
T.D.S.* for irrigation Max. 4500 ppm.
Chlorides for irrigation 0–1100 ppm.
* Total Dissolved Salts.

Table 2. Species composition of mosquito larvae in Kuwait 1987–1988.

Year	Identified specimens	Species composition of mosquito larvae samples								
		Anopheles stephensi	*An. pulcherrimus*	*Culex pipiens* complex	*Culex tritaeniorhynchus*	*C. theileri*	*C. univittatus*	*C. pusillus*	*Culiseta longliareolata*	*Aedes caspius*
1987	1856	37 (2.0%)	7 (0.4%)	1507 (81.2%)	4 (0.2%)	13 (0.7%)	14 (0.7%)	47 (2.5%)	368 (19.8%)	44 (2.4%)
1988	1810	46 (2.5%)	1 (0.55%)	1376 (76.02%)	23 (1.3%)	12 (0.61%)	12 (0.61%)	76 (4.2%)	354 (19.6%)	216 (11.9%)
Months during which larvae found		April to Dec.	Aug. to Oct.	Jan. to Dec.	June, July, Sep. to Nov.	Mar. to May, Sep. to Dec.	June to Oct., Dec.	Jan., Mar., June to Dec.	Jan to July, Sept. to Dec.	Jan. to Dec.

These are *C. pusillus*, *C. univittatus* and *C. theileri*. These species were not met here until 1981, when they were discovered associated with *A. stephensi* in breeding places slightly polluted with organic matter and particularly in brackish water. Harbach (1985) mentioned that *C. univittatus* and *C. theileri* are implicated in the transmission of filarial and arboviral diseases in humans.

Aedes caspius is the only species of the genus *Aedes* detected in Kuwait up to present time. It is found breeding particularly in seepage water and water channels containing vegetation. This species is a severe nuisance because it bites outdoors and sometime indoors, both during the day and at sunset.

Culiseta longiareolata ranks second to *C. pipiens* complex in larval population density in Kuwait (Table 2). Adults of this species never enter houses and rarely bite Man, so this species appears to be of no medical importance. Its larvae may prey on smaller individuals, which may be beneficial.

KEY TO ADULT MOSQUITOES OF KUWAIT

(1) Costa of the wings with alternating dark and pale areas . . . . . (2)
Costa without alternating dark and pale areas . . . . . (3)

(2) Costa with more than 3 dark areas, last 3 tarsal segments, white, abdominal segments with lateral tufts of pale scales . . . . . *Anopheles pulcherrimus*
Costa with more than 3 dark areas, 5th tarsal segment black, femur and tibia speckled . . . . . *Anopheles stephensi*

(3) Spiracular bristle present, wings with 3 or 4 spots formed by groups of scales, large size mosquito . . . . . *Culiseta longiareolata*
Spiracular bristle absent, wings without spots . . . . . (4)

(4) Compound eyes distinctly separated, anal cerci prominent, pulvilli absent, claws toothed, pale scales condensed to make a pale line in the middle of abdominal segments . . . . . *Aedes caspius*
Compound eyes approximate, cerci small, pulvilli present claws simple. . . (5)

(5) One or more lower mesepimeral setae present, first joint of hind tarsi distinctly shorter than tibiae . . . . . *Culex* (*Barraudius*) *pusillus*
Lower mesepimeral setae absent, first joint of hind tarsi not shorter than tibiae. . . . . (6)

(6) Proboscis and tarsi with pale rings, scales on thorax almost unicolour bright red . . . . . *Culex* (*Culex*) *tritaeniorhynchus*
Proboscis and tarsi without pale rings . . . . . (7)

(7) Femorae and tibiae with distinct pale longitudinal stripes on the anterior side . . . . . *Culex theileri*
Femorae and tibiae not striped . . . . . (8)

(8) Abdominal tergites with complete basal bands . . . . . (9)
Abdominal tergites with basal pale lateral spots only . . . . . (10)

(9) Lateral bands yellow, mesonotal scales dark reddish brown, subcosta intersects costa at or beyond level of bifurcation of R.3. . . . . *Culex pipiens* complex
Subcosta intersects costa before level of bifurcation of R.3. . . . . *Culex quinquefasciatus*

(10) Abdominal bands narrow, hind tibiae with a pale lateral stripe . . . . . *Culex univittatus*

KEY TO MOSQUITO LARVAE OF KUWAIT

(1) Siphon absent . . . . . (2)
Siphon present . . . . . (3)

(2) Inner clypeal hairs apart, outer clypeal hairs with 4–12 branches, palmate hairs on the thorax present . . . . . *Anopheles pulcherrimus*
Inner clypean hairs apart, outer clypeal hairs simple or frayed, palmate hairs on the thorax absent . . . . . *Anopheles stephensi*

(3) Siphon with only one pair of tufts . . . . . (4)
Siphon with more than one pair of tufts . . . . . (5)

(4) Siphonal tuft arising at the base of the siphon . . . . . *Culiseta longiareolata*
Siphonal tuft definitely behind the middle of the siphon . . . . . *Aedes caspius*

(5) All siphonal tufts in one single posterior row, number 10 or less, siphon about 3 times as long as broad . . . . . *Culex* (*Barraudius*) *pusillus*
Siphonal tufts in two postero-lateral rows . . . . . (6)

(6) Pecten teeth strong, curved and wide apart, with few denticles, antenna very prominent . . . . . *Culex* (*Culex*) *theileri*
Pecten teeth smaller, close together with longer or more numerous denticles . . . . . (7)

(7) Siphon not more than 5 times as long as broad, inner post antennal hair usually with 5 branches . . . . . (8)
Siphon at least $5\frac{1}{2}$ times as long as broad, inner post antennal hair usually with 3 branches . . . . . (9)

(8) Seta I of hairs on abdominal segments III & IV usually double . . . . . *Culex pipiens* complex
Seta I of hairs on abdominal segments III & IV usually single . . . . . *Culex quinquefasciatus*

(9) Antennal tuft at two thirds, siphon with one pair of small lateral tufts . . . . . *Culex tritaeniorhynchus*
Antennal tuft at three quarters, siphon with two pairs of small lateral tufts . . . *Culex univittatus*

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بعوض الكويت

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خلاصة

بالرغم من اعتبار الكويت منطقة استقبال للأمراض التي ينقلها البعوض فلم تحدث حالات نقل محلية لمسببات هذه الأمراض خاصة طفيليات مرض الملاريا والفيلاريا حتى وقتنا هذا بين مواطنيها. ولوقاية الدولة من النقل المحلي النشط لمسببات هذه الأمراض فقد بدأ قسم مكافحة الحشرات الطبية والقوارض التابع لوزارة الصحة العامة بالكويت منذ ١٩٧٥ باجراء عمليات المسح الحشري لتحديد التركيب النوعي للبعوض ومواقع توالده على مستوى الدولة لامكان متابعته بالمكافحة.

وقد أظهر المسح تواجد نوعان من بعوض الانوفيليني هي انوفيلس ستيفنساي وأنوفيلس بولكريمس ظهرت ابتداء من عام ١٩٨١ وثمانية أنواع من بعوض الكيوليسيتي منها ثلاثة أنواع وجدت معاصرة لبعوض الأنوفيل ١٩٨١ ومصاحبة ليرقاته في أماكن توالدها وهي كيولكس بوسيلس وكيولكس يونيفتاتس وكيولكس ثيليري.

أما الخمسة أنواع الأخرى فهي كيولكس ترايتينيورنكس الذي بدأ العثور على يرقاته في عام ١٩٨٧ بأعداد قليلة في حين أن بعوض كيولكس ببيانز كومبلكس (مولستس وكوينكفاشياتس) هو النوع السائد في الكويت يتبعه بعوض كيوليسيتا لونجي أريولاتا ولم يتواجد الا نوع واحد من جنس ايدس هو ايدس كاسبس.

وقد تم اعداد مفتاح تقسيمي للأنواع السابق ذكرها اضافة الى مناقشة نتائج الدراسة في متن المقال.